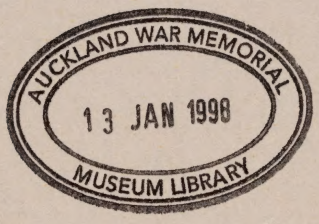
QH 197
NZ Res



RECORDS of the AUCKLAND INSTITUTE AND MUSEUM

Volume 11 December 17th, 1974

RECORDS of the AUCKLAND INSTITUTE AND MUSEUM

Volume 11 December 17th, 1974

Editor: K. A. J. WISE

Editorial Committee

Professor Roger C. Green — Anthropology

Professor F. J. Newhook — Botany

Mr J. E. Braggins — Botany

Associate-Professor Joan Robb — Zoology

Published by Order of the Council

E. G. TURBOTT, Director

Address: Auckland Institute and Museum

Private Bag, Auckland, New Zealand

RECORDS OF THE AUCKLAND INSTITUTE AND MUSEUM

VOLUME 11

CONTENTS

ARCHAEOLOGY AND ETHNOLOGY — Page

Some hafted shell adzes in the Auckland Museum.
JANET M. DAVIDSON 1

Radiocarbon dates from Sunde site (N38/24), Motutapu Island, New Zealand.
JANET M. DAVIDSON 9

Further identifications of sources of obsidian flakes from N38/37 on Motutapu Island, New Zealand.
JANET M. DAVIDSON 11

Source of obsidians from the Motutapu undefended site N38/37.
G. K. WARD 13

The pa, N43/59, at Pawhetau Point, Kawakawa Bay, Clevedon, South Auckland.
AILEEN FOX 15

Excavations at Hot Water Beach (N44/69), Coromandel Peninsula.
ANNE LEAHY 23

A functional analysis of obsidian flakes from three archaeological sites on Great Barrier Island and one at Tokoroa.
M. J. MORWOOD 77

A lintel from South Kaipara Head.
D. R. SIMMONS 101

A carving from Kaikohe.
D. R. SIMMONS 103

BOTANY

Notes on the Cheeseman Herbarium. Part 1. Exchange with U.S.A. herbaria before 1900.
JEANNE H. GOULDING 105

A note on the type of *Acaena ovina* var. *ambigua* Kirk (Rosaceae).
A. E. ORCHARD 119

ZOOLOGY

The taxonomy of some Indo-Pacific Mollusca with description of a new species. Part 2.
WALTER O. CERNOHORSKY 121

Type specimens of Mollusca in the University Zoological Museum, Copenhagen.
WALTER O. CERNOHORSKY 143

Three radiocarbon dates for Quaternary Mollusca from Northland.
C. A. FLEMING and A. W. B. POWELL 193

New Zealand Molluscan systematics with descriptions of new species. Part 8.
A. W. B. POWELL 197

New synonymy in *Cryptopygus* (Collembola: Isotomidae).
K. A. J. WISE 209

Index 213

SOME HAFTED SHELL ADZES IN THE AUCKLAND MUSEUM

JANET M. DAVIDSON
AUCKLAND INSTITUTE AND MUSEUM

Abstract. Ethnographic specimens of hafted shell adzes from the New Hebrides and the Northern Solomons are described and illustrated.

Recent excavations in parts of Melanesia and Micronesia have uncovered large numbers of bevelled shell tools, usually interpreted by the excavators as adzes. This has aroused considerable interest in how these tools were hafted and used, and Garanger has recently described a number of examples from Museum collections (1972, Figs. 299-302). Among the Auckland Museum collections are several examples of hafted shell adzes with old and authentic lashings. These are described below, to place on record interesting examples additional to those described by Garanger and in widely scattered references in earlier ethnographic literature.

A detailed study by Mead (1968) is taken as a basis for the descriptions which follow. Mead in turn followed Buck *et al.* (1930) for terminology of parts of adzes and their handles, and Buck (1944) for description of lashing patterns.

In his study, Mead distinguished between ceremonial and working adzes (1968, pp. 28-30). He found five main types of handles and five main lashing patterns. Two of his handle types are represented among the Auckland specimens: Type 1 (a branch-and-trunk handle with both heel and toe) and Type 2 (branch-and-trunk with developed toe but little or no heel) (Mead 1968, p. 374). All specimens display the multiple diamond lashing pattern (Mead 1968, pp. 37-8).

Description of adzes

Specimen 31495 O (Figs. 1, 2) from the New Hebrides consists of a *Terebra maculata* blade in a complex and ornate handle. It is part of the Oldman collection purchased by the New Zealand Government (Oldman no. 692). An old label on the handle reads "36263 Cap. E. G. Rason Com. of N.H. 1902-8".

The shell blade measures 15.8 cm in total length, with 8.2 cm visible below the lashing. It is very similar to numerous specimens recovered archaeologically from the New Hebrides (Garanger 1972, Fig. 293) and elsewhere (Davidson 1971, pp. 52-55).

The handle is complex, consisting of at least three pieces. The shaft curves up in one piece to the elaborate extremity of the heel. The toe is formed of two shaped wooden pieces forming a socket within which the blade is enclosed. The lashing on the toe binds together the blade and its socket while the upper part of the lashing attaches the toe to the rest of the handle. The distance from base of handle to extremity of heel is 50 cm; from extremity of heel to edge of blade 32 cm. In some respects this specimen resembles the rotating adzes classed by Mead as his Type 5 (1968, pp. 374, 441), but as it is now lashed, it does not rotate.

Figs, 1, 2. 1. Adze 31495 O (Oldman Collection) from the New Hebrides. 2. Detail of lashing, adze 31495 O.

The lashing is a very complex version of the multiple diamond pattern, which is seen as two patterns in the side view (Fig. 1), but as one continuous series of diamonds on the front (Fig. 2). The lashing material is a plaited three-strand cord which is almost certainly coconut fibre.

The ornate handle and lashing suggest that this was a ceremonial rather than a working adze. Yet the existence of such an elaborate artifact could not be inferred from the excavation of the blade alone.

This specimen has some resemblance to an adze illustrated by Guiart (1963, Fig. 218, p. 239). The latter, however, appears to have a blade of stone.

Specimen 41281 (Figs. 3, 4) is part of a collection of ethnographic items presented to the Auckland Museum in 1969 by a Miss Dawson. The collection belonged to her father who was a medical officer in Samoa and Tonga in the 1920s and 1930s, but no items were localised when received by the Museum. This specimen is assigned to the New Hebrides on the basis of the style of handle. It is apparently an old and authentically lashed example.

The blade is probably *Lambis* sp. and has a maximum width of 7.8 cm. The length of the visible part of the blade is 7.9 cm.

The handle is of the branch-and-trunk type with both heel and toe (Mead's Type 1), and undecorated except for the grooves on the proximal extremity of the shaft. The length of the shaft of the handle, from toe angle to base, is 39 cm; the length of the base of the foot is 22 cm, and the total distance from heel to edge of blade is 30 cm.

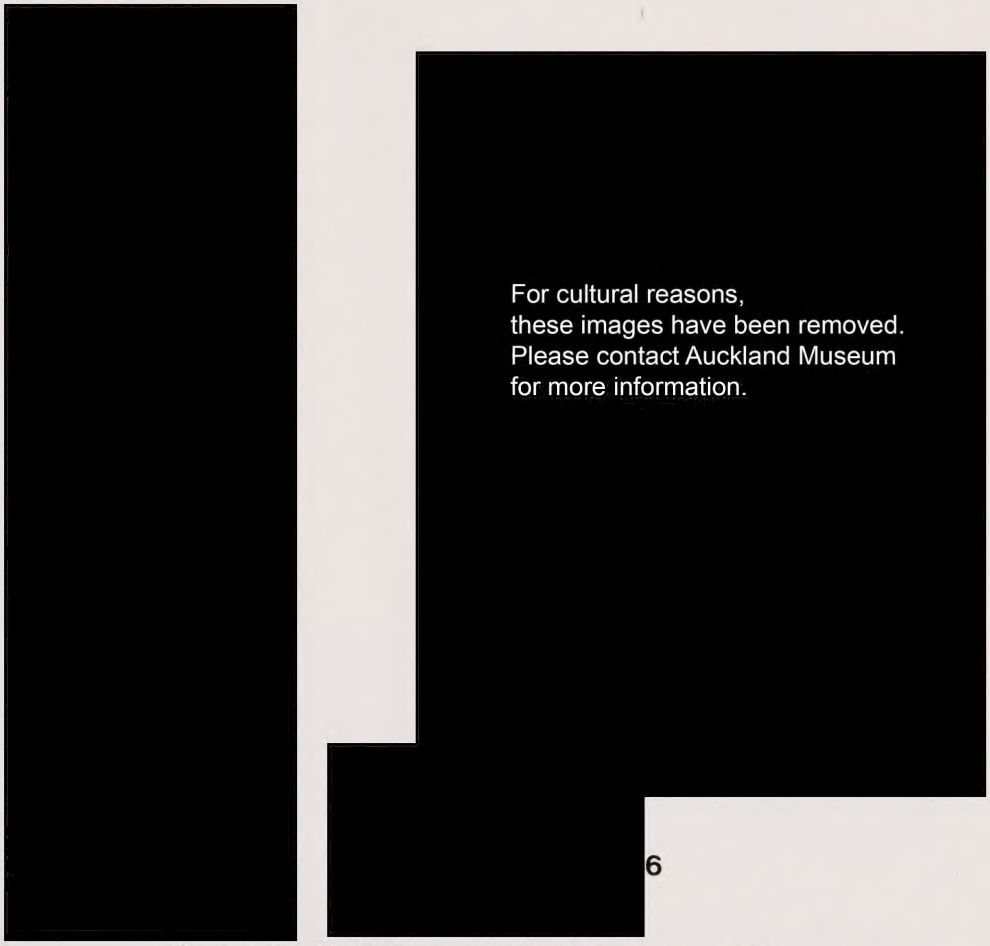
Figs. 3, 5. Adzes. 3. Adze 41281, probably from the New Hebrides. 5. Adze 11544, from Mortlock Is., Northern Solomons.

There is a complex socket. The blade rests in a shaped trough and is covered by a second wooden piece, the whole lashed tightly together. The lashing pattern is of the multiple diamond variety, with the diamonds somewhat elongated to fit the rather eliptical toe. The cord is a very fine plaited three-strand cord, similar to but finer than the cord on the previous specimen. At some time the lashing has been coated with some preparation, possibly a preservative, which now makes identification of the fibre very difficult.

Specimen 11544 (Figs. 5, 6) was purchased by the Museum in 1888 from a Mr G. Stuart. It is from Mortlock (Takuu), a Polynesian outlier in the Northern Solomons.

The blade is *Terebra maculata* with a maximum width of 4.5 cm and a length of 6.7 cm visible below the lashing. It is not possible to tell how much of the blade is concealed by the lashing.

The handle appears to be a knee of wood, rather than a branch-and-trunk fork. It conforms to Mead's Type 2. The total length of the shaft is 64 cm and the length



Figs. 4, 6. Detail of lashing. 4. Adze 41281. 6. Adze 11544.

of the foot is 24 cm. Although the handle at first glance appears rather crude the tool is, in fact, extremely well balanced.

The blade is set in a trough and lashed by the multiple diamond pattern. Part of the lashing passes around the columella of the shell blade (Fig. 6) as on a specimen from Nukuria illustrated by Garanger (1972, Fig. 302 E). The lashing material is a twisted two-strand cord of coconut fibre.

Another feature of this specimen is the "beard" — a bunch of individual coconut fibres which lie along the top of the blade under the lashing as a backing material, and extend at the distal end as a fringe.

Specimen 11543 (Figs. 7, 8), also from Mortlock, was also purchased from Mr Stuart in 1888. It is a very large and heavy specimen, said to have been used in canoe-building.

The blade is probably *Tridacna maxima,* but no sign of the outer surface of the shell remains. It is a beaked blade with hollow ground bevel and still retains a remarkably sharp edge. The total length of the blade is estimated at 27 cm, of which 15 cm is visible below the lashing.

The handle belongs to Mead's Type 2 and appears to be of the branch-and-trunk variety. The length of the shaft is 88 cm and combined length of blade and foot 58 cm. The weight of the hafted adze is approximately 3.5 kg.

Fig. 7. Adze 11543 from Mortlock Is., Northern Solomons.

Fig. 8. Detail of lashing, adze 11543.

The blade is set in a trough and lashed with a rather irregular version of the multiple diamond pattern. The lashing extends for a distance of 24.5 cm along the foot, well beyond the estimated poll of the shell blade. The lashing material is a coarse plaited three-strand cord of coconut fibre. There is no "beard". This specimen may be compared with the large shell adzes from Tikopia, which were also lashed with a "criss-cross" pattern (Firth 1959, p. 151).

The Auckland Museum collections also contain three other specimens very similar to no. 11544. Two of these, nos. 37615 and 37616, are also from Mortlock. They were acquired in 1964. In both, the handle is of the branch-and-trunk type rather than a knee. One blade is *Terebra maculata,* but the other appears to be *Conus.* In each case the cord and lashing are the same as on the older example. The "beard" and the passing of the lashing around the columella are present. Both specimens are lighter and less securely lashed, and appear to reflect continued knowledge of how to lash such tools, without the necessity for them actually to be used.

The third specimen, no. 14953, is from the Edge-Partington collection and has an Edge-Partington label which reads NEW HEBRIDES LEPERS ISLAND ADZE WITH TEREBRA SHELL (TIL) BLADE FOR INSIDE OF CANOES. The number at the base of the label is illegible but a later hand has added Q82. The specimen consists of a *Terebra maculata* blade attached to a Type 2 branch-and-trunk handle by a cord and lashing pattern identical to those on the Mortlock specimens. This adze is quite different from Leper Island (Aoba) examples illustrated by Codrington (1891, p. 314) and by Edge-Partington himself (1890, 1, pl. 148 no. 14) so its provenance may not be correct.

Discussion

Mead in his study of hafted adzes drew several tentative conclusions from the distribution of types of handles and lashing patterns. He found that the Type 1 handle had an extremely wide distribution throughout Oceania and was probably an ancient form. The Type 2 was most common in Western Polynesia, with scattered occurrences also in Fiji, New Caledonia, the Solomons and New Guinea. The multiple diamond

lashing pattern was present in East Polynesia, Micronesia and Melanesia and was probably also an ancient form. Mead also noted that different traits in the complex associated with hafted adzes (blades, handles, lashing, decorative elements) diffused independently of each other.

The specimens described above are of interest, firstly, as good examples of hafted shell adzes, and secondly, because they illustrate some of the different combinations which can occur, as a result of the wide distribution of various aspects of the hafted adze complex.

Numerous ethnographic descriptions of hafted adzes show that there was great variety in lashing as well as handles. It is nonetheless of interest that all the examples described here, from two of the principal shell adze making areas of Melanesia, the New Hebrides and the Polynesian outliers in the Northern Solomons, have the multiple diamond lashing pattern. The same lashing pattern is applied to widely different handle types, and to both ceremonial and working adzes. The handles themselves appear to provide the best guide to the provenance of the complete artifact, with the exception of the Edge-Partington specimen, if it is in fact from Leper Island.

It is also of interest to note that identical *Terebra* shell blades were applied to different sockets, in quite different types of handles, in the two different island groups. Conversely, the same type of handle within one island group could accommodate quite different blades, as for example, the *Terebra* and stone blades of the ceremonial adzes of the New Hebrides.

There is undoubtedly considerable scope for further studies of hafted adzes in the Pacific.

Acknowledgements. I am grateful to Mr C. Schollum, Department of Anthropology, University of Auckland, for photographing the specimens. Miss J. Goulding, Auckland Institute and Museum, identified the coconut fibre in the lashings.

REFERENCES

BUCK, Peter H.

1944 Arts and Crafts of the Cook Islands. *Bull. Bernice P. Bishop Mus.* 179: 1-533.

BUCK, Peter H., Kenneth P. EMORY, H. D. SKINNER and John F. G. STOKES

1930 Terminology for ground stone cutting-implements in Polynesia. *J. Polynes. Soc.* 39 (2): 174-180.

CODRINGTON, R. H.

1891 *The Melanesians. Studies in their anthropology and folk-lore.* Clarendon Press, Oxford. 419 pp. illus.

DAVIDSON, Janet M.

1971 Archaeology on Nukuoro Atoll, a Polynesian Outlier in the Eastern Caroline Islands. *Bull. Auckland Inst. Mus.* 9: 1-108.

EDGE-PARTINGTON, James

1890 *An album of the weapons, tools, ornaments, articles of dress, etc, of the natives of the Pacific Islands.* Issued for private circulation by James Edge-Partington and Charles Heape. 2 vols. 391 pl.

FIRTH, Raymond

1959 Ritual adzes in Tikopia. *In* J. D. Freeman and W. R. Geddes (Eds.) *Anthropology in the South Seas.* Avery, New Plymouth. pp. 149-159.

GARANGER, Jose

1972 Archéologie des Nouvelles-Hébrides. *Publication de la Société des Océanistes,* No. 30. ORSTOM, Paris. 156 pp. 304 figs.

GUIART, Jean

1963 *The Arts of the South Pacific.* Translated by Anthony Christie. Thames and Hudson. 461 pp. illus.

MEAD, S. M.

1968 Polynesian hafted adzes: a comparative study of form and decoration. Unpublished Ph.D. dissertation, Southern Illinois University.

RADIOCARBON DATES FROM THE SUNDE SITE (N38/24), MOTUTAPU ISLAND, NEW ZEALAND

JANET M. DAVIDSON
AUCKLAND INSTITUTE AND MUSEUM

Two radiocarbon dates have been received for the Sunde site, N38/24, on Motutapu Island. Excavations at this site were described by Scott (1970). More recently, I have discussed its position in the prehistoric sequence on the island (Davidson 1972).

The two charcoal samples that have been dated were collected during Scott's excavations in 1963, and submitted to the N.Z. Institute of Nuclear Sciences by R. C. Green in 1973.

The results are as follows.

NZ 1898 charcoal from oven beneath Rangitoto ash	
$\delta^{13}C$ w.r.t. PDB	— 24.5‰
percentage modern w.r.t. 0.95 NBS Ox.Ac.Std.	92.6 ± 0.6%
^{14}C age w.r.t. 0.95 NBS Ox.Ac.Std.	610 ± 60 years B.P.
^{14}C age calculated according to new half-life and corrected for secular effect	640 ± 60 years B.P.
NZ 1899 charcoal from level 4, square A-1	
$\delta^{13}C$ w.r.t. PDB	— 25.2‰
percentage modern w.r.t. 0.95 NBS Ox.Ac.Std.	92.3 ± 0.9%
^{14}C age w.r.t. 0.95 NBS Ox.Ac.Std.	620 ± 70 years B.P.
^{14}C age calculated according to new half-life and corrected for secular effect	630 ± 70 years B.P.

One sample is from beneath the Rangitoto ash and the other is from the first occupation above the ash. They therefore provide further evidence on the age of the ash shower, and an indication of the time which may have elapsed before the reoccupation of the site after the eruption.

Sample NZ 1898 is the first from a cultural context beneath the ash. Previous dates on samples from beneath the ash have been on what appeared to be natural plant remains, or in one case, shell from beach sand. The result falls within the range of previous results for samples from beneath the ash and makes a fourteenth century age for the eruption more likely. The assessment of radiocarbon dates for Rangitoto eruptions is the subject of a paper by Law (n.d.). Here it is sufficient to note that this most recently obtained result supports a probably slightly younger age for the ash shower than that originally suggested by Brothers and Golson (1959), and confirms that the occupation ceased probably just before, or at the onset of the eruption, as the nature of the remains preserved beneath the ash suggested.

It is now evident that the occupation beneath the ash on Motutapu is not particularly early, in the wider context of New Zealand prehistory. Radiocarbon dates of comparable or earlier age are now becoming available for agricultural sites on the

Auckland mainland (Sullivan pers. comm.). It is unlikely that the Sunde site represents a Settlement Phase occupation for the greater Auckland area, although it may represent the initial occupation of this part of Motutapu. The layer should probably be reassigned to the Archaic Phase.

Sample NZ 1899 is slightly more difficult to interpret. Its age is not significantly different from the date beneath the ash. The date can probably be taken to indicate that people returned to the Sunde site very shortly after the eruption. It is unlikely that the charcoal represents redeposited material from the occupation beneath the ash, for the ash layer at the site is thick, and there is no evidence of it being penetrated by postholes or other features. On the other hand, it is possible that the people who occupied the site after the eruption found and burned wood of comparable age to that used in the oven before the eruption. However, in view of the cultural continuity between the pre- and post-eruption layers (Davidson 1972) and convincing evidence for resettlement of lava fields within decades by Polynesians in Samoa and Hawaii, a rapid return to the Sunde site after the eruption seems likely.

In summary then, these two dates suggest that a brief period of time elapsed between the abandonment of the site before or at the time of the eruption, and its recolonisation after the eruption. It is probable that these events took place during the fourteenth century A.D.

REFERENCES

BROTHERS, R. N. and J. GOLSON

1959 Geological and archaeological interpretation of a section in Rangitoto ash on Motutapu Island, Auckland. *N.Z. J. Geol. Geophys.* 2 (3): 569-577.

DAVIDSON, Janet M.

1972 Archaeeological investigations on Motutapu Island, New Zealand. Introduction to recent fieldwork, and further results. *Rec. Auckland Inst. Mus.* 9: 1-14.

LAW, R. G.

n.d. Radiocarbon dates for Rangitoto and Motutapu, a consideration of the dating accuracy. Submitted for publication.

SCOTT, Stuart D.

1970 Excavations at the "Sunde site", N38/24, Motutapu Island, New Zealand. *Rec. Auckland Inst. Mus.* 7: 13-30.

FURTHER IDENTIFICATIONS OF SOURCES OF OBSIDIAN FLAKES FROM N38/37 ON MOTUTAPU ISLAND, NEW ZEALAND

JANET M. DAVIDSON
AUCKLAND INSTITUTE AND MUSEUM

Further identifications of the sources of obsidian flakes found in the Motutapu undefended site N38/37 have been made. The results are described by Ward (this volume).

Site N38/37 was excavated in 1967-68 and has been previously described (Davidson 1970). Obsidian found in the site was initially sorted according to whether it was "grey" or "green" and the distribution within the site discussed according to these categories (1970, pp. 47, 53). The "green" was assumed to be from Mayor Island. More recently, obsidian from this and two other Motutapu sites was analysed by Dr R. Reeves of Massey University (Davidson 1972, Appendix 1). Only two of the flakes studied by Reeves were from N38/37; one was found to be from Mayor Island and the other from Great Barrier Island.

Only "grey" pieces were submitted to Ward. The expectation that most or all would prove to be from Great Barrier Island has been confirmed. It is of particular interest, however, that the Huruiki source is represented by three specimens, and that two separate sources on Great Barrier Island are distinguished.

I argued previously (1972, p. 7) that Huruiki obsidian may have been present only during the earlier phases of occupation on Motutapu, since it was then known only from the Sunde site (N38/24). Ward's analysis, however, shows it to have been present also in the later N38/37 site, although only in small quantity. It is obvious that the routes by which obsidian reached Motutapu were complex, since in each of the three small sites so far considered, obsidian from at least three different sources is present.

The other point of interest arising from the analysis of the obsidian from N38/37 is the distribution of material from the different sources within the site. Most of the obsidian came from layers A and B, so there is little scope for a diachronic analysis. The interest lies rather in the horizontal distribution in different parts of the site.

The obsidian studied by Ward came from the three main areas of concentration in the site: the terrace on the northern slope (squares N-8 and O-8); the area immediately above (M-8, M-9), which included structure B; and square J-11 on the south-eastern slope. The material from the Te Ahumata source (Ward's 1), which predominates in the site, was also most common in all three areas. The material from the other sources, however, was widely distributed, with one piece from Huruiki (Ward's 2) in each of the three areas, and the Awana material represented by three

pieces from the northern terrace and one from square M-9. This tends to confirm the pattern already apparent in the distribution of "grey" and "green" flakes, that material from a particular source does not cluster in a particular part of the site, or around a particular structure.

REFERENCES

DAVIDSON, Janet M.

1970 Excavation of an "undefended" site, N38/37, on Motutapu Island, New Zealand. *Rec. Auckland Inst. Mus.* 7: 31-60.

1972 Archaeological Investigations on Motutapu Island, New Zealand. Introduction to recent fieldwork and further results. *Rec. Auckland Inst. Mus.* 9: 1-14.

SOURCE OF OBSIDIANS FROM THE MOTUTAPU UNDEFENDED SITE N38/37

G. K. WARD
AUSTRALIAN NATIONAL UNIVERSITY

Thirty pieces of obsidian from the Motutapu undefended site N38/37 (Davidson 1970, 1972) were submitted for chemical characterisation by X-ray fluorescence spectography. Several were too small for preparation; 24 fragments were prepared and analysed according to the techniques outlined elsewhere (Ward 1972). The results of the spectrographic analyses are given in Table 1.

These data were compared with a previously derived reference configuration which included data from 18 major source localities (Ward 1973, 1974a), using a statistical method of comparison (Ward 1974b). This resulted in the following allocations to source groups being made (Table 2).

It will be seen that all 24 obsidians are allocated to three obsidian source localities within the Hauraki Gulf area, all with acceptably high figures for associated probability. Two of these sources, Te Ahumata (1) and Awana (37) are located on Great Barrier Island, and the third, Huruiki (2), on the adjacent mainland. All sources are within 75 km of Motutapu. These results compare with those obtained by Reeves (Davidson 1972, p. 13, Appendix 1) for obsidian from this and other Motutapu undefended sites, which indicate a majority of "Great Barrier Island" obsidian, but none from the Huruiki source.

Acknowledgements. I am grateful for the assistance of Mr J. S. Whitton and Dr R. J. Furkert of the Soil Bureau, D.S.I.R., in processing the obsidian samples, and Ms M. Rose of the A.N.U. in adapting program OBSCURE to UNIVAC 1108 hardware.

REFERENCES

DAVIDSON, Janet M.

1970 Excavation of an "undefended" site, N38/37, on Motutapu Island, New Zealand. *Rec. Auckland Inst. Mus.* 7: 31-60.

1972 Archaeological investigations on Motutapu Island, New Zealand. Introduction to recent fieldwork and further results. *Rec. Auckland Inst. Mus.* 9: 1-14.

WARD, G. K.

1972 Obsidian and New Zealand Archaeology. A paradigm for sourcing artefact assemblages using X-ray fluorescence spectrography. Unpublished M.A. thesis, University of Otago.

1973 Obsidian source localities in the North Island of New Zealand. *N.Z. Archaeol. Ass. Newsl.* 16 (3): 85-103.

1974a A paradigm for sourcing New Zealand archaeological obsidians. *J. R. Soc. N.Z.* 4 (1): 47-62.

1974b A systematic approach to the definition of sources of raw material. *Archaeometry* 16 (1): 41-53.

Table 1. Trace element proportions of twenty-four obsidians from N38/37.

ACCESSION NUMBERS* AI & M	OU	Element Composition in ppm Zr	Mn	Ti	Rb	Sr
AR 874	AS 056	134	230	654	309	61
AR 878	AS 057	109	212	678	284	14
AR 878	AS 058	110	257	531	289	01
AR 882	AS 059	188	337	733	222	15
AR 885	AS 060	79	155	509	176	16
AR 887	AS 061	88	195	795	298	01
AR 887	AS 062	185	377	744	228	23
AR 887	AS 063	84	204	636	198	02
AR 887	AS 064	93	201	600	274	05
AR 905	AS 065	100	217	665	254	07
AR 905	AS 066	93	230	484	240	09
AR 912	AS 067	113	243	708	287	09
AR 912	AS 068	64	181	643	187	10
AR 915	AS 069	135	177	655	323	23
AR 926	AS 070	85	184	600	205	06
AR 926	AS 071	211	396	732	257	32
AR 926	AS 072	104	250	643	240	00
AR 930	AS 073	83	187	649	221	10
AR 938	AS 074	111	127	623	268	14
AR1062	AS 075	131	198	615	231	17
AR1062	AS 076	143	222	643	203	38
AR1067	AS 077	149	186	641	292	14
AR1067	AS 078	95	226	674	306	07
AR1070	AS 079	124	156	674	324	05

* AI & M — Auckland Institute and Museum Archaeology Dept catalogue numbers.
OU — Dept of Anthropology, University of Otago, accession numbers.

Table 2. Allocation of twenty-four obsidians from N38/37 to three Hauraki Gulf obsidian source localities.

Accession Numbers	Allocated to Source Group Number	Name	Associated Probability
AS 056	37	Awana	0.91
AS 057	1	Te Ahumata	0.87
AS 058	1	Te Ahumata	0.97
AS 059	37	Awana	0.63
AS 060	2	Huruiki	1.00
AS 061	1	Te Ahumata	0.97
AS 062	37	Awana	0.77
AS 063	1	Te Ahumata	0.89
AS 064	1	Te Ahumata	0.97
AS 065	1	Te Ahumata	0.92
AS 066	1	Te Ahumata	0.89
AS 067	1	Te Ahumata	0.87
AS 068	2	Huruiki	0.91
AS 069	1	Te Ahumata	0.88
AS 070	1	Te Ahumata	0.87
AS 071	37	Awana	0.96
AS 072	1	Te Ahumata	0.94
AS 073	1	Te Ahumata	0.89
AS 074	1	Te Ahumata	0.97
AS 075	1	Te Ahumata	0.80
AS 076	2	Huruiki	1.00
AS 077	1	Te Ahumata	0.95
AS 078	1	Te Ahumata	0.94
AS 079	1	Te Ahumata	0.99

THE PA, N43/59, AT PAWHETAU POINT, KAWAKAWA BAY, CLEVEDON, SOUTH AUCKLAND

AILEEN FOX
AUCKLAND INSTITUTE AND MUSEUM

Abstract. A large and imposing headland pa defended by three transverse ditches is described and its economic resources are discussed. After examination of the archaeological and historical evidence, the site is tentatively identified as the residence of Te Haupa, chief of the Ngati-Paoa in the early nineteenth century.

This large and well defended pa is situated on the headland on the west side of Kawakawa Bay known as Pawhetau Point. It was the first site that I saw for myself soon after my arrival in Auckland in February 1973, and at that time it typified the similarities and the differences between the promontory forts and cliff castles of the Iron Age, with which I was familiar in Britain, and the Maori fortifications I had come to New Zealand to study. Since it was a complex site, a full-scale survey was needed, which was carried out under the direction of Karel Peters.

SITUATION (Figs. 1, 2)

Kawakawa Bay is situated where the land on the west side of the Firth of Thames is broken by the narrow channels between Ponui, Pakihi, and Karamuramu Islands, giving access to the Tamaki strait and the mouth of the Wairoa river. To the north, the island group is continued by the larger land mass of Waiheke Island, so that viewed from the distant Coromandel, or from the water as first seen by Cook, it looks like a continuous coast. The area, then, topographically is part of the Thames region, though its present-day links are with Clevedon and Papakura inland. The coast was known in the early nineteenth century as Ware-Kawa (Wright 1950, p. 158).

The wide bay, over 2 km across, is shallow, with extensive muddy sand exposed at low tide, and is surrounded by a ring of steep-sided hills (Figs. 1, 2). The fortified headland is at the the northen end of a 60 m ridge that extends from this ring and which, together with the adjoining Waitawa headland, forms the watershed between the small streams that drain into the bay and those which flow to the Wairoa estuary. The site commands a wide view north-east across the bay to the Hauraki Gulf and to the distant heights of the Coromandel. Geologically, the underlying formation consists of indurated sedimentary rocks of Mesozoic origin, turbidites, finely bedded sandstones and siltstones belonging to the Waiheke group (Eastern Facies). These rocks are exposed at the Point and on the adjoining beach. The soil elsewhere on the promontory is a yellowish clay, technically a leached northern yellow-brown earth, as described by the Soil Survey, and now is regarded as of low fertility (Gibbs *et al.* 1968, p. 62, N.Z. Soil Bureau 1973).

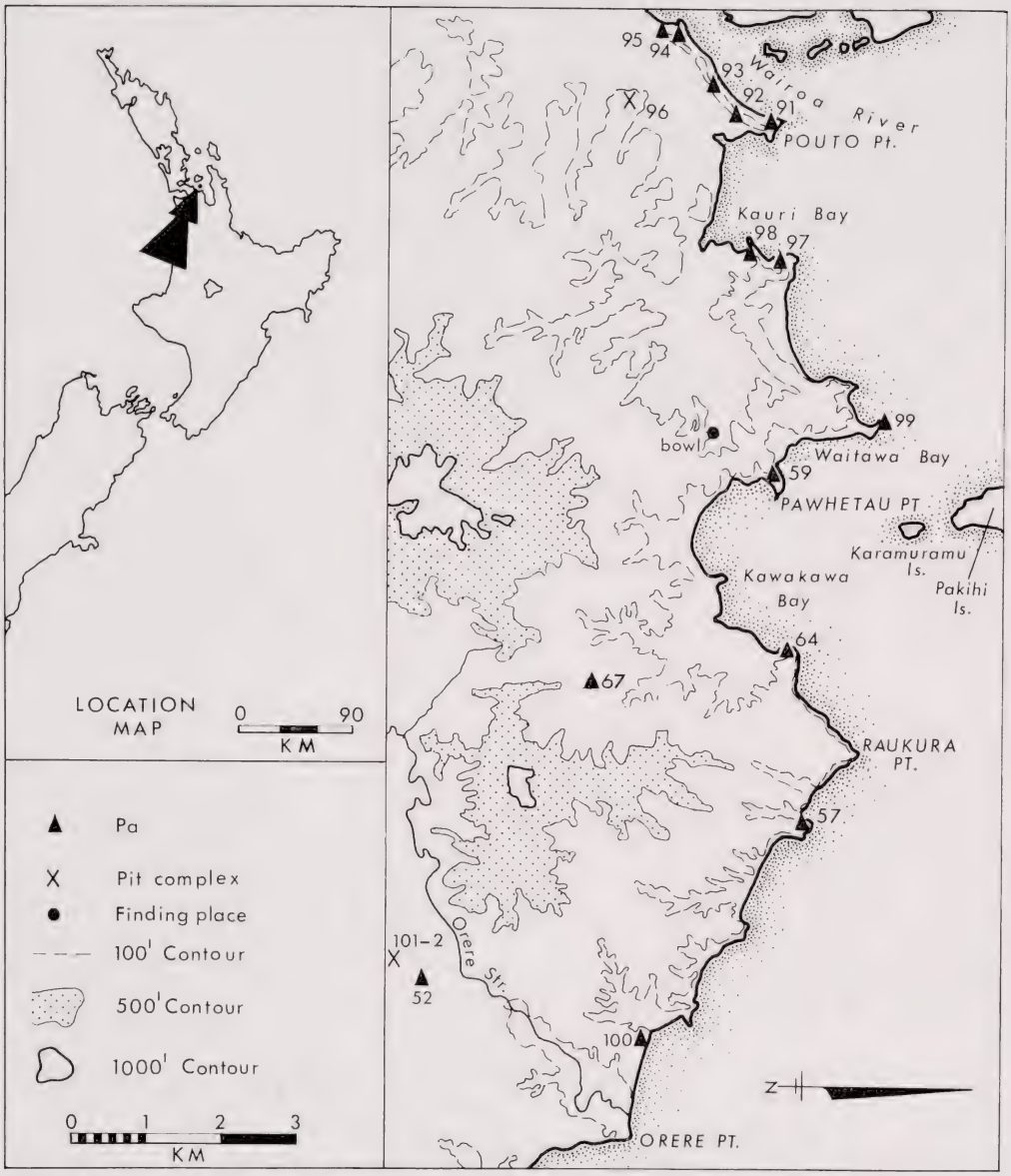
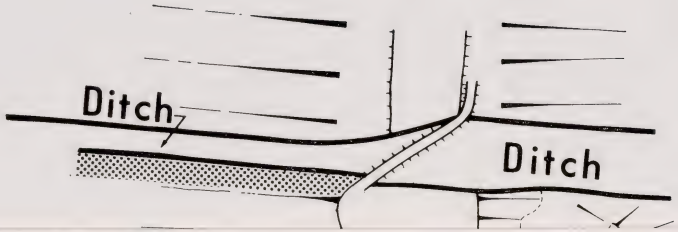


Fig. 1. Location map and distribution of pa and other sites in the vicinity of Kawakawa Bay.

Site Description (Fig. 4)

THE DEFENCES

The headland is naturally well defended by steep slopes on either side to the sea and by a lateral valley with a stream on the south-east. The only line of easy approach is from the south along the narrow level top of the spur, which was barred by three transverse ditches and associated banks, spaced at intervals of 18 and 60 m (Fig. 3). In addition, there is a short length (20 m) of ditch with an external bank dug diagonally


Ditch
Ditch

0 2 4 6 8 1
METRES

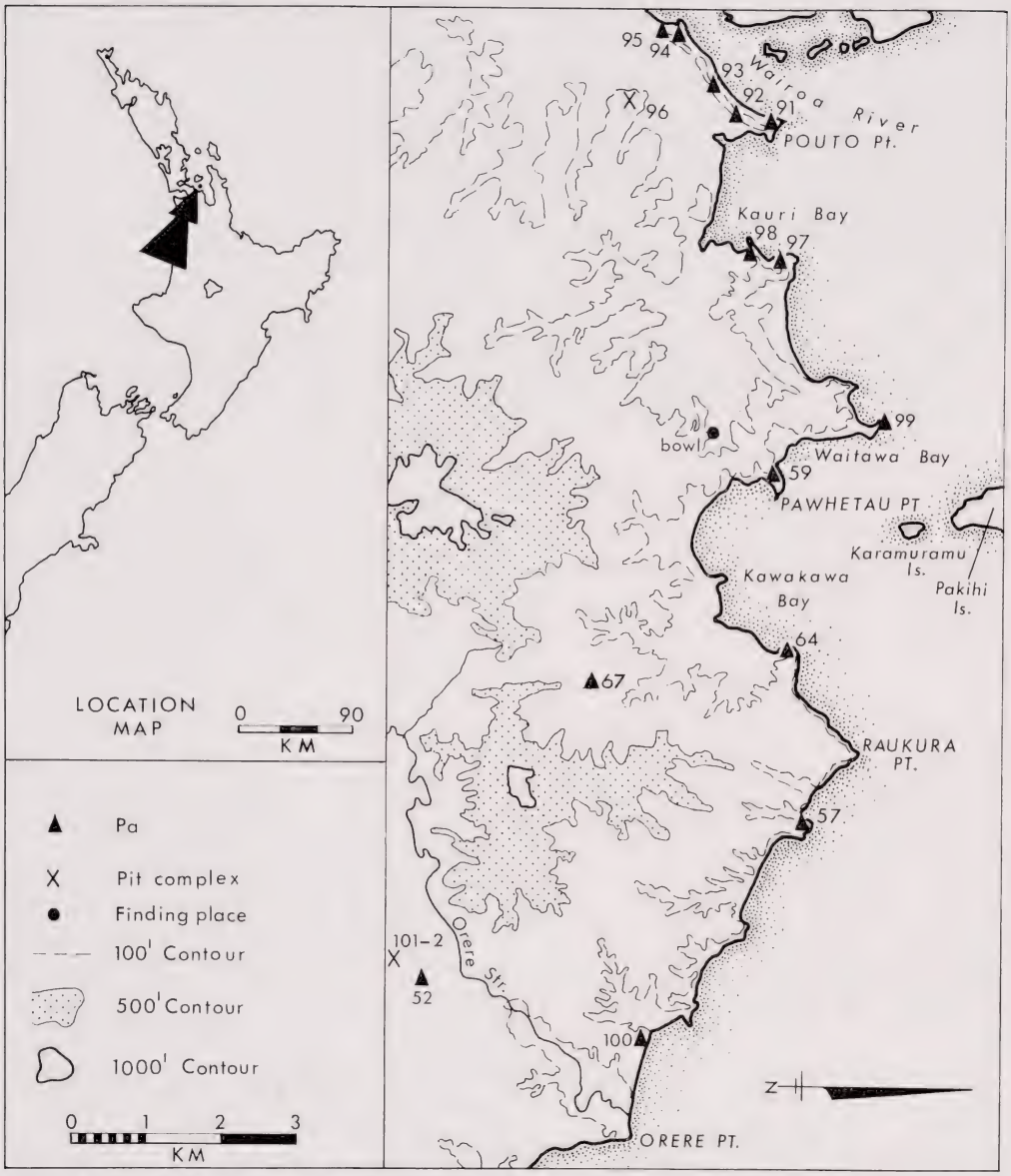


Fig. 1. Location map and distribution of pa and other sites in the vicinity of Kawakawa Bay.

Site Description (Fig. 4)

THE DEFENCES

The headland is naturally well defended by steep slopes on either side to the sea and by a lateral valley with a stream on the south-east. The only line of easy approach is from the south along the narrow level top of the spur, which was barred by three transverse ditches and associated banks, spaced at intervals of 18 and 60 m (Fig. 3). In addition, there is a short length (20 m) of ditch with an external bank dug diagonally

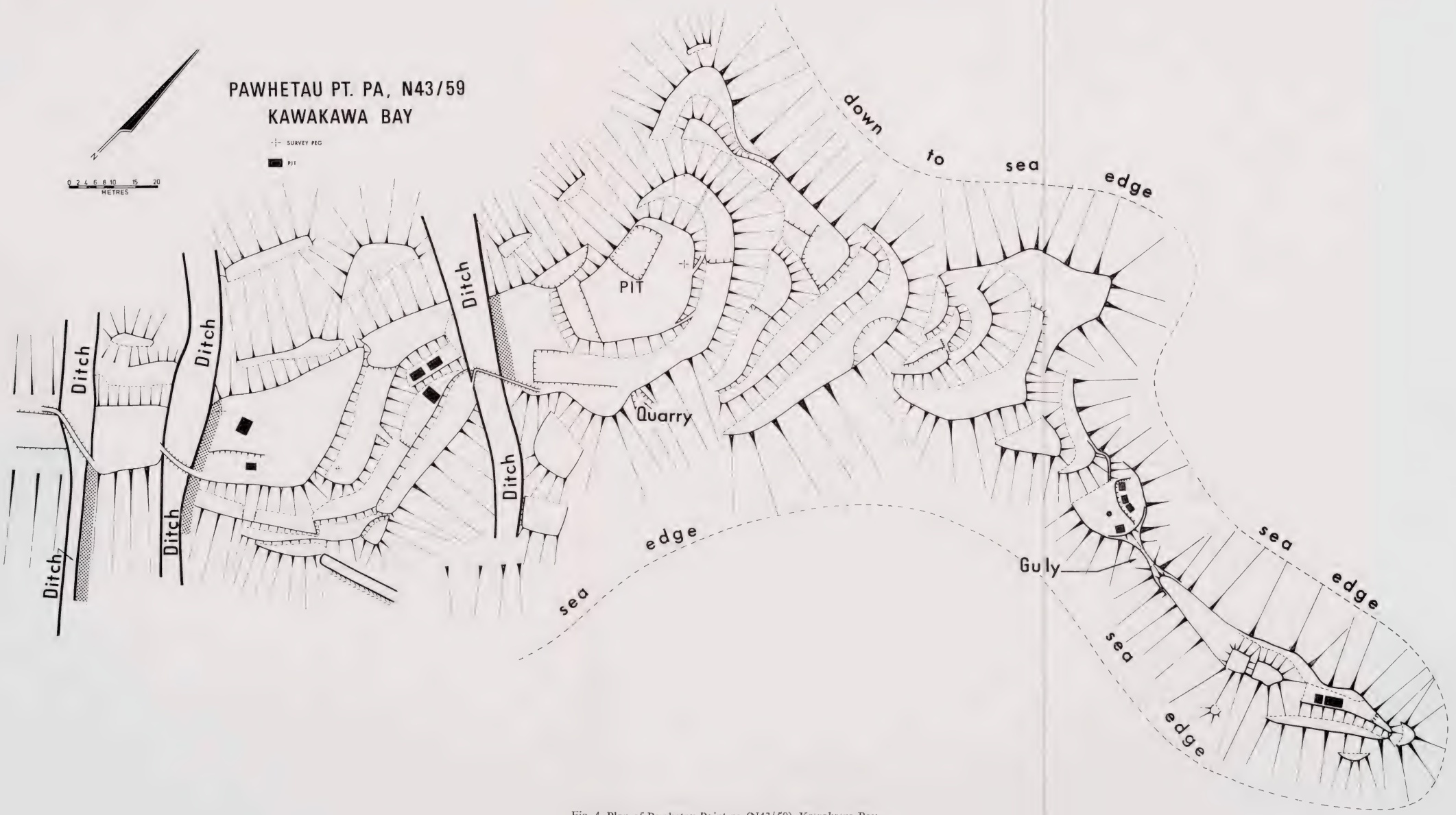


Fig. 4. Plan of Pawhetau Point pa (N43/59), Kawakawa Bay.

Fig. 2. Aerial view of Pawhetau Point pa with Kawakawa Bay in background. (Photo, White's Aviation).

on the south-east hill slope, presumably to cover a possible lateral approach up from the Kawakawa shore or from the side of the valley. The three ditches measure 7.6, 6.8 and 11.7 m wide respectively, and from 2 to *ca.* 3.5 m deep; they were dug for some 30 m down the slope on either side of the ridge. The banks are small in comparison with the ditches, measuring about 3 m wide and one metre high; it is clear that part of the ditch soil went to make a flattened surface on the ridge instead of heightening the banks. The outermost ditch has no internal bank across the ridge top, although this is present on the slope (Fig. 4). Instead, the soil was used to build up an external platform 8 x 12 m and about 0.5 m high, which screened the entrance and may have carried a fighting stage. This would ensure visual control over a dip in the ridge on the line of approach.

The banks are not of sufficient bulk to act as a defensive rampart; their function was to increase the height and lengthen the scarp of the ditch, making it more difficult to cross, and to protect the base of the palisade, of which the main timber uprights would have been deeply bedded in the subsoil, as Bellwood (1971, pp. 68-69) demonstrated at Otakanini pa, South Kaipara. The entrance through the defences is at the south-east edge of the ridge; in each case it was by a narrow path on a ledge about 0.5 m wide, crossing the ditches diagonally and leading to a small gap in the rampart.

Fig. 3. Ground view of Pawhetau Point pa looking north-east from Kawakawa Bay. (Photo, W. Bourke).

There was a line of weakness at the south-west end of the third ditch where the slopes ease, and there is a small re-entrant valley, which made an attack from the shore of Kawakawa Bay feasible at this point. To cover this, two terraced "flats", 6 x 8 m and 10 x 8 m, were constructed on the main defensive scarp, abutting on the ditch and flanking the probable line of attack. It is clear that these are secondary constructions, since the soil to make them has been quarried from farther along the defensive scarp (see quarry on Fig. 4); they may have carried fighting stages. The remainder of the pa will have been fortified by palisades: a thick line on the plan (Fig. 4) indicates the likely position for the principal defence at the crest of the major scarps; this was probably supplemented by others lower down on the seaward slope.

THE INTERIOR

The pa is divided into three zones by the ditches. The first zone is flat and was apparently unoccupied, probably being kept clear for defence and for the reception of visiting chiefs and their followers. The second zone also has a level area on the ridge summit though two pits and shell midden indicate occupation. A lower area adjoining the third ditch and continuing along the south-east slopes is divided by scarps into 7 or 8 terraces and platforms on which there is a group of three rectangular storage pits. It is possible that there was a subsidiary entrance on this side of the pa, screened by the diagonal ditch and bank previously mentioned (p. 16). The third zone occupied the highest part of the ridge (60 m, 198 feet), with a perimeter defined by formidable scarps up to 7 m long. It consists of a flat area behind the rampart, again for defence, a sickle-shaped lower terrace, and an irregular-shaped summit platform or *tihi,* linked to the terrace by diagonal paths across the dividing scarp. At the end of the terrace, overlooking the sea, there is a house site defined by low banks, measuring 6.2 x 4.3 m. On the summit there is a large oblong pit, 12 x 8 m and 0.75 m deep, probably a

roofed kumara store (Fox 1974). In effect, this zone forms a citadel for the pa, in which the chief's dwelling would be located, probably on the highest point.

Beyond this, the spur changes direction to an east to west alignment, and narrowing, falls steadily and steeply to about 15 m above sea level, where it is interrupted by an erosion gully which provides an easy way down to the beach. The whole descent has been elaborately terraced and subdivided for occupation and at the lower levels scarped for defence. On the lowest terrace there are four small rectangular and one circular storage pits: the contents, probably kumara, would have been brought to the site most easily by sea.

The occupied area did not end at the gully, for although its sides have been extensively steepened for defence, a narrow causeway was left, crossing to the rocky Pawhetau Point. The crest of the promontory (30 m) which is practically an island, has been levelled to make a square platform, which affords a good look-out over the bay, and there is terracing, two pits, and deposits of shell midden at the end of the point.

Summary and Discussion

The pa on Pawhetau Point was obviously a site of major importance in the lower Thames region. It would be a formidable place to attack, whether along the ridge where there were three successive earthworks to cross, or from the sea up the very steep terraced slopes, presumably defended with palisades. The whole site is over one kilometre long. It contains some 40 terraces in addition to the *tihi* on the summit of the third enclosure, and if it be accepted that each of these housed a family, or in the case of the larger examples an extended family group, the pa could accommodate between 300 and 500 adults. Such a population is commensurate with the effort involved in building the triple earthworks and the palisades. It is evident from the extensive terracing on the seaward side of the headland, extending even on to Pawhetau Point, as well as on the steep slopes facing Waitawa Bay, that the population was expanding during the occupation and there was need to create level ground for housing, even if it were outside the main defences. In times of stress the inhabitants could retreat behind the fortifications. The same phenomenon was noticed by Captain Cook at the pa he described in Mercury Bay (Reed & Reed 1969, p. 62).

The economic advantages of the site are its easy access to seafoods, fish from the open water and shellfish from the beaches. There is a good landing place for canoes on the beach facing Karamuramu Island, on the north side of the point. F. W. Shawcross (1967, p. 107) has shown by his study of the midden at Galatea Bay on the nearby Ponui Island that the principal catch was snapper, taken in the summer season probably by net, of which a proportion were gutted and dried. Shells in the midden deposits which are exposed in many parts of Pawhetau pa are mostly pipi and cockles, with some scallops, gastropods, and the occasional oyster. Fernroot presumably was the staple carbohydrate. Judging by the few storage pits visible, kumara played a secondary role in the food supply, though it is significant that a large pit is situated on the *tihi,* which probably contained the chief's personal store. Birds could be taken and berries gathered in the bush on the hills a short distance inland. Water was available from the stream in the valley about 100 m downhill.

The distribution of recorded settlement sites based on a rapid field survey (Fig. 1, Appendix 1) shows that the nearby coastal district was thickly populated, with a major concentration on the ridge flanking the Wairoa estuary, formerly islanded by swamp, though not all sites are likely to have been occupied at any one time. In comparison with Pawhetau Point, these are all small pa, defended by short lengths of transverse ditch, and are likely to have held some 40-80 people. Only the pa on Pouto Point, which has two lines of ditches and banks 30 m apart, is built to a somewhat analogous design. Field survey, therefore, enables us to recognise the Pawhetau Point pa as a major tribal centre, a *hapu* pa, and to seek for an historical context.

As is well known, the tribe occupying the west side of Thames in the early nineteenth century was the Ngati-Paoa. Their headquarters, when visited by the missionary Henry Williams in the 1830s, was at Whakatiwai, near Kaiaua (New Brighton). Earlier, however, the area was visited by Samuel Marsden and J. L. Nicholas, in the brig *Active,* from the Bay of Islands in January 1815, who have both left accounts of the visit. After passing Point Rodney and Cape Colville, which Marsden, like Cook, called the heads of Thames, early next morning found them "pretty far up the harbour in which there were several islands both on the east and west side.", which should refer to the Waiheke-Ponui and Whanganui groups. "About eleven o'clock we came opposite the residence of the head chief [*ariki*] Houpa [Te Haupa], . . . a man much esteemed as well as feared and possessed very great power." (Elder 1932, p. 103). Nicholas, who calls him Shoupa, states that his authority reached from Thames to Bream Bay (Nicholas 1817, 1, p. 393). The chief came out in a canoe, came on board and invited them to anchor and to visit his residence nearby. Marsden (Elder 1932, p. 104), however, preferred to press on with a favourable wind noting "We then made sail for the mouth of the river [Thames]. We were then on the west side of the harbour, about four leagues from its mouth.", thus establishing that Te Haupa's residence was situated beyond the islands, but not within the firth or river mouth. Later, after a stormy passage, they landed at a village on the west bank, and from there visited another of Te Haupa's fortified settlements a mile away, inhabited only by one of Te Haupa's wives, the men being away at war (Nicholas 1817, 1, p. 399). On the return journey, adverse winds unfortunately prevented Marsden visiting Te Haupa's residence as he had promised, for which he expressed regret (Elder 1932, p. 108). Such topographical details as Marsden provides are compatible with the situation of Pawhetau Pa and its commanding view over the Hauraki Gulf and the route of the *Active,* and though the identification cannot be pressed, since it is based on the assumption that a notable earthwork can be equated with a notable man, the possibility that this pa was once a residence of Te Haupa should be kept in mind.

The prehistory of the site and its archaeological development could only be ascertained by extensive excavation. A casual find of human bones by two schoolboys a few years ago on one of the seaward terraces was dated by its collagen contents to about A.D. 1600, by the Institute of Nuclear Sciences (R2548 350±80 B.P.), and suggests that the site had a long prehistoric occupation. Another indication is the large zoomorphic wooden bowl with a spout acquired by the Auckland Museum (No. 44626) and illustrated by Simmons (1973, p. 63, Fig. 12). This was found concealed in a swamp on the west side of the ridge less than a mile away from the pa. Simmons (1973, p. 61) has emphasised that the fine carving is typical of the

Hauraki (Thames) style and is perhaps of 17th century date. The attribution is consistent with Ngati-Paoa ownership.

The occupation of Pawhetau pa must have come to an end at latest during the Ngapuhi attacks of the 1820s. Te Haupa had died in an epidemic soon after Marsden's visit, which, according to D'Urville (Wright 1950, p. 158), had led his descendants to move farther north along the Hauraki gulf. In 1833, when Henry Williams was at the mouth of the Wairoa, the district was deserted: "The rocks were covered with oysters and *pipis* on the mud banks . . . and the sea full of fish of all kinds. It was melancholy to look around . . . no bustle of civil life. No vessels, boats or canoes moving . . . over the surface of these waters . . . The hills in the rear are clothed with timber without rendering service to any. Traces of former Towns and settlements were visible as we came along and where'er we turned, but all were either destroyed, taken captive or fled." (Rogers 1961, p. 340).

Acknowledgements. Permission for the survey was readily granted by Imperial Chemical Industries, through Mr R. E. Ellis of the Auckland office. I am grateful to two students, Mr J. Spencer of the Auckland Technical Institute, and Mr M. Ibbotson of the University of Auckland, for helping with the survey, and the Department of Anthropology at the University for assistance, especially Mr Karel Peters, Technical Officer, who is responsible for the final form of the illustrations.

APPENDIX I

LIST OF SITES PLOTTED ON FIG. 1.

Site No.	Grid ref.	Name	Character	Defences
N43/52	734 448	Orere School	Ridge pa	2 tranverse ditches and banks
N43/57	710 501	Waiti Bay	Headland pa	Transverse ditch and bank
N43/59	659 500	Pawhetau Point	Headland pa	3 transverse ditches and banks
	This paper			
N43/64	686 502	Kawakawa Bay	Headland pa	2 transverse ditches and scarps
N43/64A	686 500	Kawakawa Bay	Terraced site	—
N43/67	688 470	Kawakawa Bay Orere Road	Ridge pa	Transverse ditch and bank
N43/91	608 499	Pouto Point	Headland pa	2 tranverse ditches and banks
N43/91A	609 499	Pouto Point	Pit group	—
N43/92	603 492	Wairoa estuary	Ridge pa	1 transverse and 1 lateral ditch and scarp
N43/93	601 490	Wairoa estuary	Ridge pa	2 transverse ditches
N43/94	596 486	Wairoa estuary	Ridge pa	Short transverse bank only
N43/95	595 484	Wairoa estuary	Terraced site with pits	—
N43/96	605 478	Kawakawa Bay Road	Pit group	—
N43/97	628 501	Kauri Bay	Headland pa	Transverse ditch and bank
N43/98	626 496	Kauri Bay	Ridge pa	Transverse ditch and bank
N43/99	651 516	Koherurahi Point	Headland pa	2 transverse ditches
N43/100	739 480	Puatiti Bay	Ring ditch pa	Ditch and scarp
N43/101	734 443	Orere	Pit group	4 pits and platform
N43/102	734 439	Orere	Pit group	11 pits and 3 platforms

REFERENCES

BELLWOOD, P.

1971 Fortifications and economy in prehistoric New Zealand. *Proc. Prehist. Soc.* 37: 56-95.

ELDER, J. R. (Editor)

1932 *The letters and journals of Samuel Marsden 1765-1838.* Coulls Somerville Wilkie and A. H. Reed, for Otago University Council, Dunedin. 580 pp.

FOX, Aileen

1974 Prehistoric Maori storage pits: problems in interpretation. *J. Polynes. Soc.* 83: 141-154.

GIBBS, H. S., J. D. COWIE and W. A. PULLAR

1968 Soils of the North Island. *N.Z. Soil Bur. Bull.* 26 (1): 48-67.

N.Z. SOIL BUREAU

1973 Map of parent rocks of New Zealand soils, 1:1,000,000, North Island. *N.Z. Soil Surv. Rep.* 5.

NICHOLAS, J. L.

1817 Narrative of a voyage to New Zealand. 2 vols. (facsimile ed.). Wilson and Horton, Auckland.

REED, A. H. and A. W. REED (Editors)

1969 *Captain Cook in New Zealand.* 2nd ed. Reed, Wellington. 262 pp.

ROGERS, L. M. (Editor)

1961 *The early journals of Henry Williams, 1826-1840.* Pegasus Press, Christchurch. 524 pp.

SHAWCROSS, F. W.

1967 An investigation of prehistoric diet and economy on a coastal site at Galatea Bay, New Zealand. *Proc. Prehist. Soc.* 33: 17-131.

SIMMONS, D. R.

1973 Anthropomorphic and zoomorphic Maori bowls from Hauraki and the Bay of Plenty. *Rec. Auckland Inst. Mus.* 10: 59-64.

WRIGHT, O.

1950 *New Zealand 1826-1827. From the French of Dumont D'Urville.* Wingfield Press for Olive Wright, Wellington. 251 pp.

EXCAVATIONS AT HOT WATER BEACH (N44/69), COROMANDEL PENINSULA

ANNE LEAHY
AUCKLAND

Abstract. Salvage excavations, carried out in 1969 on a beach midden site, produced a considerable amount of bone, shell and artifactual material, together with carbon 14 dates and a well defined Loisels pumice horizon. There were three main layers, one of which was associated with the Loisels pumice.

Hot Water Beach is situated on the east coast of the Coromandel Peninsula, about 19 km south-east of Whitianga (Figs. 1, 2).

The coarse yellow sand beach drops fairly steeply to the sea along most of its 1.6 km length. It may be divided into two main areas. The longer north-western portion of the beach is backed by dunes which separate the coast from the low lying swampy area stretching for several kilometres inland. A shallow sandy stream at the northern end drains this swamp. The shorter south-eastern section is separated from the northern end by a promontory which juts out into the beach and against which the water laps at high tide. Below this promontory the hot springs, from which the beach gets its name, bubble up through the sand at low tide. On the east side of the promontory another stream flows out to sea. It is deeper and faster flowing than the northern one and, although it is superficially sandy, its base consists of large water-worn stones. These continue to the east end to form a boulder beach. This stream has a different watershed and rises in hills rather than a swamp. On the promontory is a headland pa (N44/14). The cliffs surrounding the pa are still covered by remnants of coastal forest. It is on the sandy flats across the stream from the pa that the site (N44/69) is situated. These flats stretch back 200 or 300 m to where the edge of the hills rise steeply to the top of the ridge.

Hot Water Beach lies at what could be considered to be the southern boundary of a discrete territorial area. To the north is the deep indentation of Mercury Bay, on the west are the reaches of the Whitianga Harbour and its tidal estuaries, and the southern boundary is formed by the Whenuakite River valley. These natural features surround a block of hilly land and ridges, which is divided into two equal parts by the Purangi River. The western block, whose northern end forms Cook's Beach, has little flat land, but the eastern and more coastal area has a series of low hills and ridges divided by streams and small valleys.

South of the Whenuakite valley and Hot Water Beach the country becomes very rugged and mountainous as far as the Tairua Harbour some 12 km (8 miles) south in a direct line.

Within this area of about 25 km^2 (10 square miles) are found islands, rocky coasts, ocean beaches, tidal estuaries, river flats, sources of stone and forests. Obsidian is found south of Cook's Bay and the rivers contain boulders of quartz, chert and other siliceous

Fig. 1. Location map, Hot Water Beach and surrounding area.

Fig. 2. General view of site N44/69 showing eastern stream beach and hot spring area below promontory at upper left.

material. All these economic necessities are within about a 12 km (8 mile) radius of the site which is on the southern extremity of this very rich area.

The only recorded source of basalt in the vicinity is the Tahanga Quarry (N40/8) at Opito Beach which lies to the north just outside the area being described. However, it would be an easy journey by sea to Tahanga to collect or trade this adze and flake material.

The Excavation

Early in 1969 Mrs A. McCartney of Hamilton drew the attention of the Auckland Museum to a site at Hot Water Beach. She had found artifactual material in the eroding dunes near the beach access road, investigated the area and established that the material was coming from two main layers, a lower yellow sand layer and above that a black greasy charcoal one. Amongst the material recovered were bone and dentalium reel units and a side-hafted adze.

In July 1969, Janet Davidson, Mrs McCartney and I spent a day at the site and put down a trial excavation. Five layers were established at that time.

In August 1969, a group under the auspices of the Auckland Museum spent a week working there.

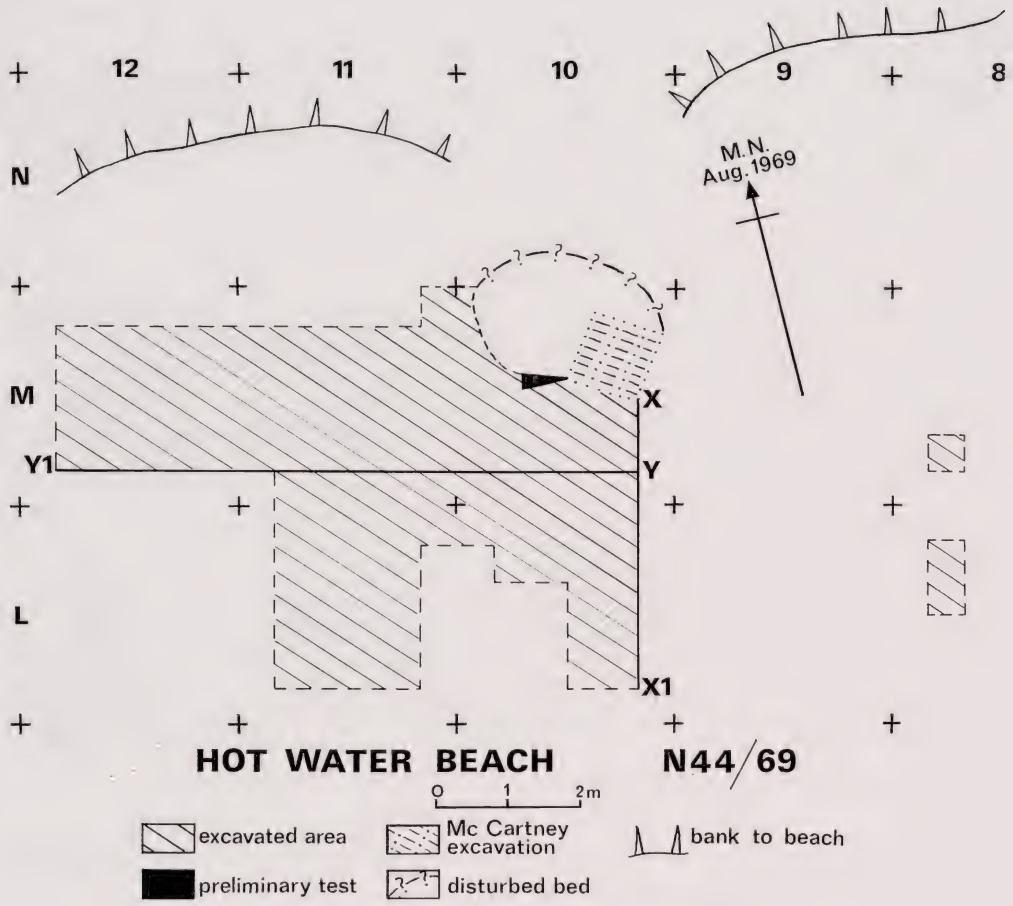


Fig. 3. Ground plan of excavated area N44/69.

A datum peg was established at X 1 (Fig. 3) and base-line X 1 — X was laid down in an approximately north - south line (a plan relating the position of the excavation to present survey pegs is on file in the Auckland Museum). A second base-line Y — Y 1 at right angles, 3 m north of X 1, established the east - west line. From these, 3 m squares were set out. Letters were assigned for the north-south lines and numbers for the east-west lines (Fig. 3, cross-sections Figs. 4, 5). Squares M 10, M 11, and L 10 were lined out as 2 m squares with 50 cm baulks. These were excavated first and as work progressed, squares M 12 and finally L 11 were investigated. Four 2 m squares, M 10, M 11, M 12, and L 11 were completed, but only a portion of square L 10 was fully excavated. All excavated material was sieved through a one-third inch mesh and a limited amount of sorting done at that stage. In squares M 10 and L 10 large stones, large pieces of pumice and broken shells were checked and if not artifacts were discarded. Later all sieved material except large stones was bagged for subsequent sorting.

Although the weather was fine and fairly windless, the drying out and collapsing of the sandy baulks was a constant problem so that the squares, as soon as they had

been completed, were photographed, sections drawn and then partially filled in wherever it was possible. This meant that the whole site was never exposed completely at one time. However, the base-line X — X 1 (Figs. 3, 5, 6) remained exposed as a control throughout the excavation.

The area dug in each square was:

Square M 10	—	4.5 m^2
Square L 10	—	4.25 m^2
Square M 11	—	7.5 m^2
Square L 11	—	5.25 m^2
Square M 12	—	5.0 m^2

As work progressed, six layers were finally identified, five of which were practically continuous over the whole area dug while one, layer 6, was found in pockets below layer 5. Of these six layers, four were occupation layers but layer 6 produced a very small amount of cultural material compared with the other three occupation layers. The pockets of layer 6 rested on sterile beach sand, which in turn covered a ground base of large water-worn stones; probably a continuation of the north-eastern boulder beach. These boulders were uncovered in squares M 10 and L 10, but as the work progressed, excavation was not continued below the sterile sand.

It is not known how far the site extended seawards. Flooding of the stream could have caused its mouth to swing westwards to the base of the promontory, or

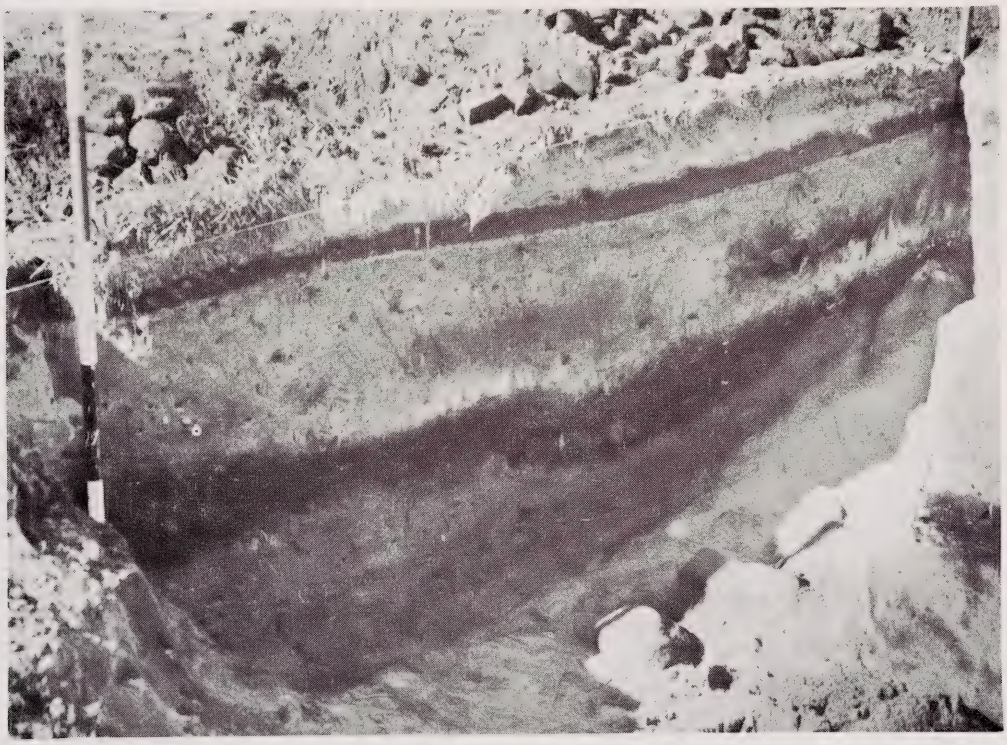


Fig. 6. Photo of baseline baulk X — X 1 Squares M 10, L 10 East Baulk.

east to where the boulder beach is exposed. The deposits of cultural material seemed to be at their maximum in the M 10 and M 11 area, suggesting that the stream edge was further north formerly than it is now, and that possibly the central area of layer 6 and the seaward portion of layers 5 and 4 had been eroded away by stream bed changes. All the layers except layer 6 had been affected by the use of this part of the beach for motor access to the water, and a large part of the north side of the site had been disturbed by fossicking (Fig. 3).

In general all layers tended to be fairly even in their distribution but showed a gradual thinning towards the west of the site.

An estimate was made of the volume of each layer dug (see below, p. 53) and the following cultural layers presented these volumes:

Layer 3b — 4.505 m^3
Layer 4 — 3.701 m^3
Layer 5 — 4.081 m^3
Layer 6 — not estimated

A portion of square M 10 had been fossicked north and east of the McCartney excavation. This disturbed material was removed, sieved and bagged, as a considerable amount of cultural material was present. The fill from the McCartney and preliminary test digs was also removed, where present in the square, until the unexcavated face was established and work proceeded from there.

Although the cultural material from the disturbed area could be assigned to no layer, it seems reasonable to assume that the disturbed cultural material could be associated with layers 4 and 5, as layers 6 and 3b were present only at the south end of square M 10.

Two test areas were dug eastwards of the baulk line X — X 1 to try to establish what layers were present where the land rose gradually towards the ridge. A 50 cm pit was dug in the south-west corner of square M 8 and a 50 cm x 1 m trench was placed along the west side of square L 8.

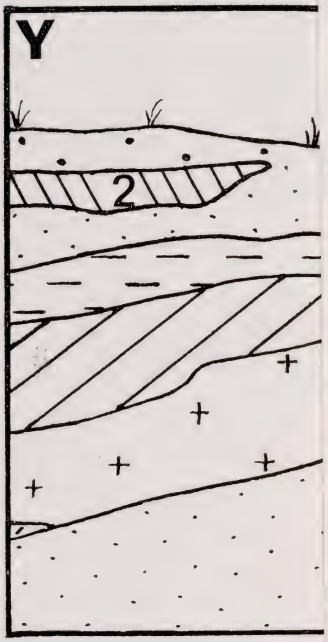
STRATIGRAPHY AND FEATURES

Layer 1

This was recent wind-blown sand covering the area unevenly. It supported a heavy growth of lupin and weeds along the area between the beach and the present camping ground. On the road access portion of the site, mainly over squares M 10 and L 10, it was barely present.

Layer 2

This was almost continuous over the excavated area except where it had been worn away by traffic on the access road and at one point where it had been cut through. This was in the unexcavated eastern baulk of square L 11 and the corner just protruded into square L 11. This cut removed a small portion of layer 2 in the south-eastern area of a pit in layer 3b. However, the main surface of the pit was



surface s
& grass

consolidat
charcoal &

sterile sa

gray-yellc
sand

east to where the boulder beach is exposed. The deposits of cultural material seemed to be at their maximum in the M 10 and M 11 area, suggesting that the stream edge was further north formerly than it is now, and that possibly the central area of layer 6 and the seaward portion of layers 5 and 4 had been eroded away by stream bed changes. All the layers except layer 6 had been affected by the use of this part of the beach for motor access to the water, and a large part of the north side of the site had been disturbed by fossicking (Fig. 3).

In general all layers tended to be fairly even in their distribution but showed a gradual thinning towards the west of the site.

An estimate was made of the volume of each layer dug (see below, p. 53) and the following cultural layers presented these volumes:

Layer 3b — 4.505 m^3
Layer 4 — 3.701 m^3
Layer 5 — 4.081 m^3
Layer 6 — not estimated

A portion of square M 10 had been fossicked north and east of the McCartney excavation. This disturbed material was removed, sieved and bagged, as a considerable amount of cultural material was present. The fill from the McCartney and preliminary test digs was also removed, where present in the square, until the unexcavated face was established and work proceeded from there.

Although the cultural material from the disturbed area could be assigned to no layer, it seems reasonable to assume that the disturbed cultural material could be associated with layers 4 and 5, as layers 6 and 3b were present only at the south end of square M 10.

Two test areas were dug eastwards of the baulk line X — X 1 to try to establish what layers were present where the land rose gradually towards the ridge. A 50 cm pit was dug in the south-west corner of square M 8 and a 50 cm x 1 m trench was placed along the west side of square L 8.

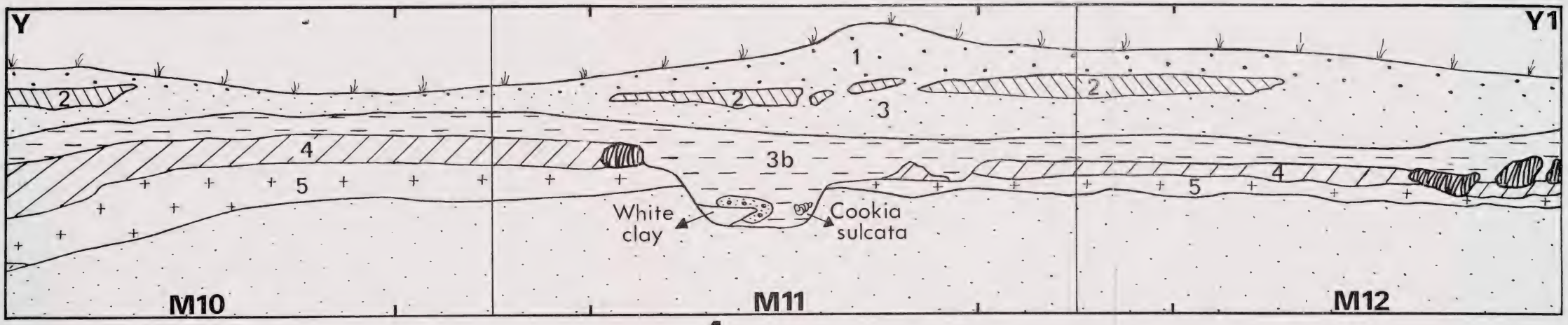
STRATIGRAPHY AND FEATURES

Layer 1

This was recent wind-blown sand covering the area unevenly. It supported a heavy growth of lupin and weeds along the area between the beach and the present camping ground. On the road access portion of the site, mainly over squares M 10 and L 10, it was barely present.

Layer 2

This was almost continuous over the excavated area except where it had been worn away by traffic on the access road and at one point where it had been cut through. This was in the unexcavated eastern baulk of square L 11 and the corner just protruded into square L 11. This cut removed a small portion of layer 2 in the south-eastern area of a pit in layer 3b. However, the main surface of the pit was

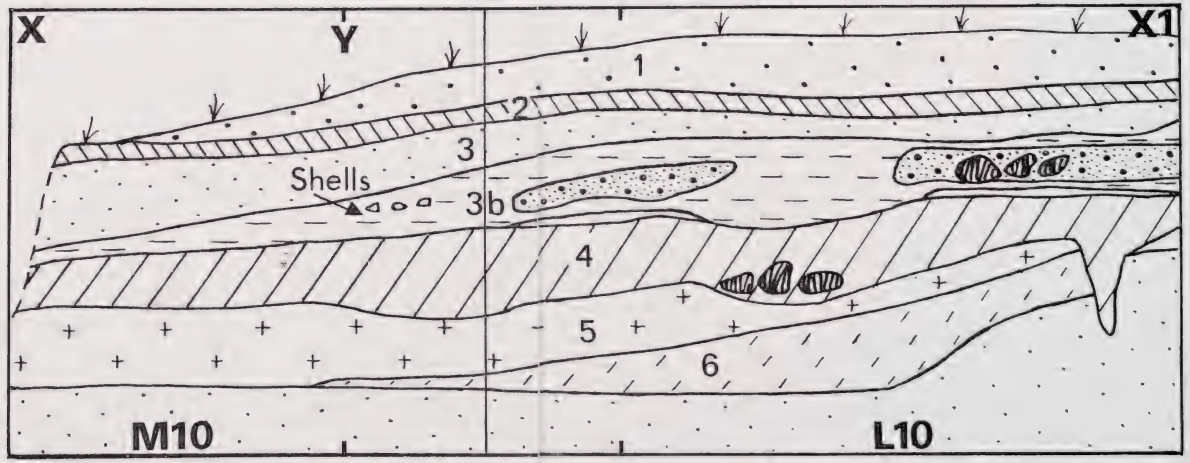


4

surface sand & grass
charcoal & sand
yellow sand
consolidated charcoal & sand
white sand
yellow-gray sand
sterile sand
haangi stones
gray-yellow sand
greasy charcoal & sand

HOT WATER BEACH
N44/69

0 1m



5

Figs. 4, 5. 4. Cross-section Y — Y 1 Squares M 10, M. 11, M 12 South Baulk. 5, Cross-section X — X 1 Squares M 10, L 10 East Baulk.

covered by undisturbed layer 2 material and clearly sealed it. Layer 2 was a distinctive sterile layer of browny-black consolidated sandy material of an almost constant thickness (8-10 cm). Its formation was probably due to the deposit of water-washed earth and charcoal from the burning off of bush and early farming activities.

Layer 3 and 3b

These were considered to be one sterile layer during the preliminary excavation and the initial excavation of square M 10. Towards the M 10-L 10 baulk it became apparent that cultural material was beginning to occur in the lower level of layer 3. There were occasional thin lenses of sterile sand resting on the hard pan of layer 4, between the cultural material of layer 3b and layer 4, which suggested that the site had been abandoned at the end of the layer 4 occupation but not for long enough to build up any depth of sterile deposit. The consolidated nature of layer 4 would soon form a surface from which sterile blown sand would be dispersed or stamped down by human activity.

Although the activity of this layer was probably peripheral to the main cultural centre, it was sufficient to leave a residue of midden material, a few features, and artifacts. The build up of the sterile upper portion, layer 3, probably started before the final abandonment of the site, as layer 3b merged imperceptibly with layer 3 and was finally sealed by layer 2.

The 3b cultural layer thinned out in the site to the north as it neared the sea and layer 3 thickened and took its place.

Feature 1 (Fig. 7) was a hangi which measured 75 cm across, with the stones more numerous on the west than on the east side. It shows in the baulk (Figs. 5, 6).

Feature 2 was another hangi, 60 cm across, part of which entered the baulk (Figs. 5, 6). Both were interspersed with greasy black sand and charcoal.

Feature 3 was a very eroded pit cutting across in a north-west south-east direction and measuring approximately 3.5 x 2.5 m. The bulk of this feature was situated in square L 11 with just the northern tip appearing in square M 11 (Figs. 4, 7). It was 114 cm below datum at the M 11 end and deepened slightly at the square L 11 end to 120 cm below datum. It cut through layers 4 and 5 and its floor was cut into the sterile yellow sand of the natural beach. It was filled with a dark grey layer of sand mixed with assorted midden material including several pieces of moa bone, one-piece fish-hook pieces and shell as well as other material. On the north-east side of the pit wall in the M 11 area was a lump of clay in the fill, which could have been similar to that of feature 15 in layer 4, although it was rather whiter in colour. Above and extending further into the fill was a layer of sand and charcoal which could also be of similar composition to that of layer 4. This suggests that the pit was filled in deliberately and that layer 4 material may have been used for part of the fill. The rest of the fill was composed of a greyish-yellow sand. There was considerable breakdown of the sides of the pit owing to the unstable nature of the sand, but it did not give the impression that it had been exposed to the elements for any length of time in the deeper portions. Along the north-east side of the pit there was some

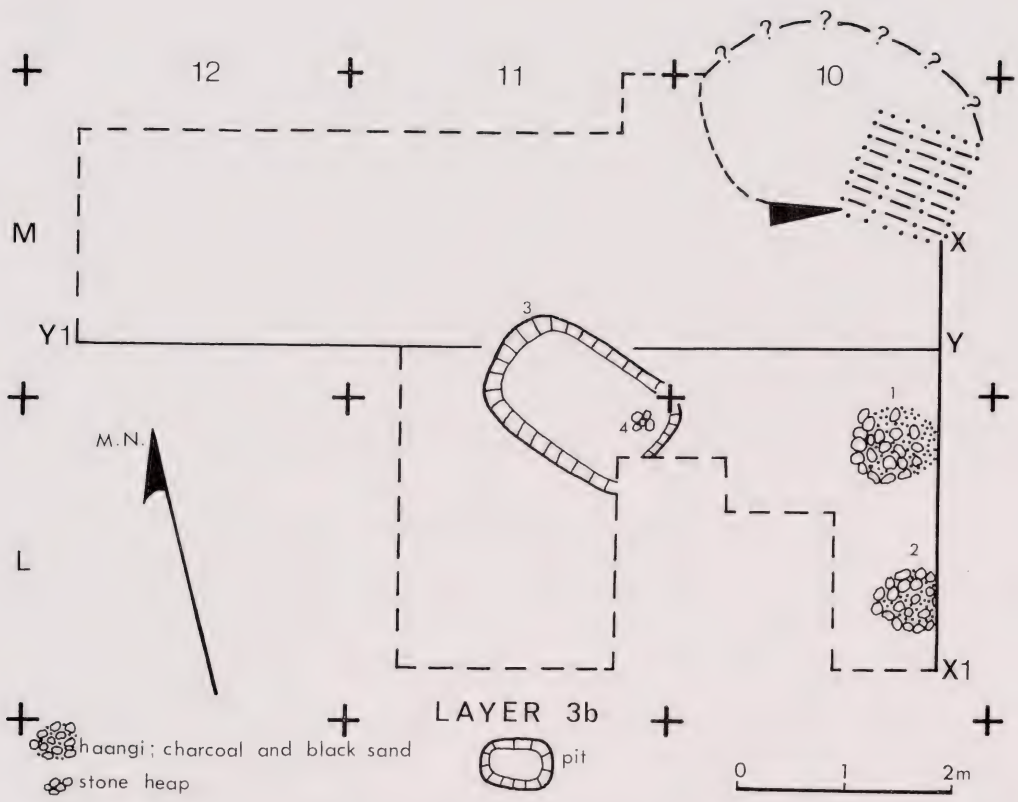


Fig. 7. Floor plan, Layer 3b, N44/69.

suggestion of a ledge which angled towards the straight edge of hangi 13 in layer 4 (Fig. 8). This might have supported a covering which rested against the hangi stones, but the ledge was not continuous and may have been caused by weathering of the upper section.

Feature 4 was a small pile of five stones on the floor of the pit at the south-east end. They seem to have been stacked rather than to have fallen in. There were no post holes in the floor of the pit and none surrounding it.

Layer 4

This was a black compact "greasy" layer averaging about 14 cm in thickness, but the "greasy" component became less evident as the layer thinned out to a grey-black, less consolidated, sandy material near the west side of the site. Scattered throughout the layer were a considerable number of blackened stones, presumably used as hangi stones. Some of the large heaps contained stones of 20 cm or more in diameter. These were similar to the stream and boulder beach ones, found locally.

A considerable amount of midden and artifactual material, much of it blackened by fire, was present. Squares M 10 and L 10 contained a large proportion of material

which was charred. The cultural material was similar to that of layer 5 but in reduced quantities.

Evidence for structures was found in this layer (Fig. 8). There were two apparent groupings of post holes and several scattered ones. Holes 2, 3 and 4 seemed associated with a hangi area and holes 16, 17, 19 and 20 could have been related to the firepit-hangi 18 or have a different purpose such as part of a shelter or house.

Post hole 1 was found during the preliminary test in July (Fig. 3). It was cut from layer 4 and through layer 5 to the sterile sand below. It was 154 cm below datum at its pointed base (all the depths and widths are approximate because of the problem of excavating in sand). It was filled with a grey-black sand.

Post holes 2, 3 and 4 originated from layer 4 and cut through layer 5 to sterile sand. They all had pointed bases and were filled with grey-black sand. Their depth was 140 cm below datum, and diameter 16 cm. These post holes followed a slightly curved east-west alignment.

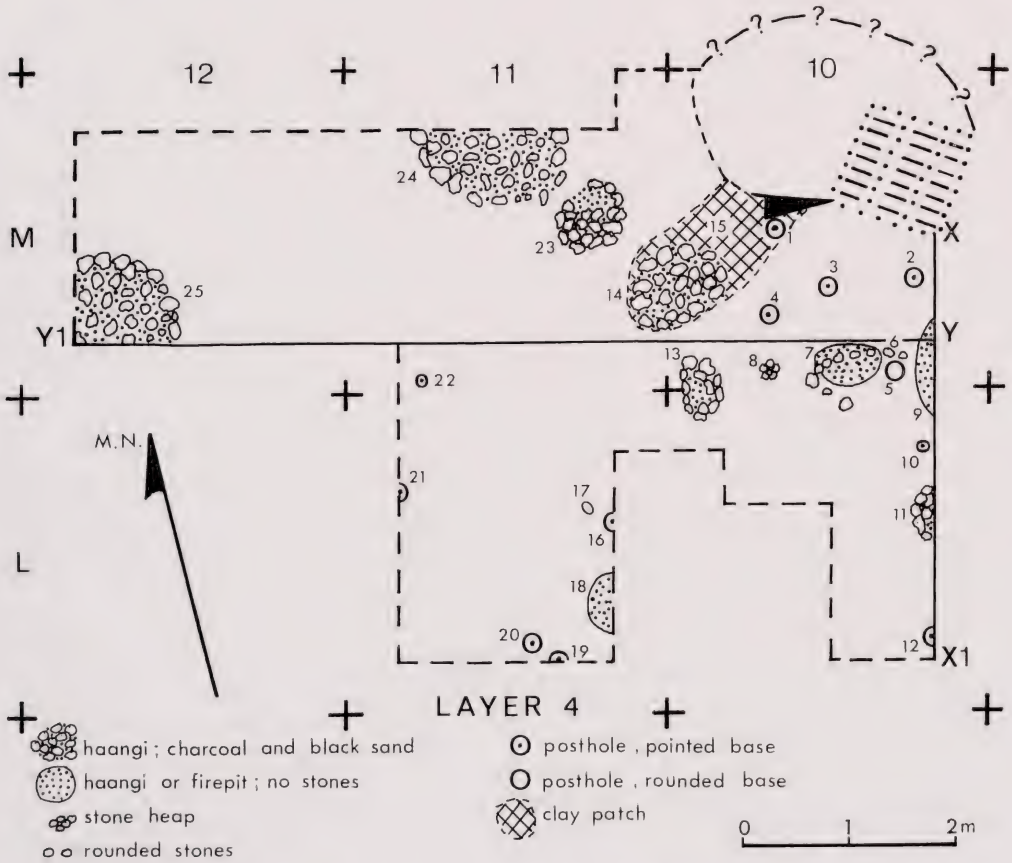


Fig. 8. Floor plan, Layer 4, N44/69.

Post hole 5 was situated at the east end of a semi-circle of stones, the most eastern two of which curved round the north side of the hole. It originated in layer 4, was filled with coarse yellow sand and just cut through into layer 5. It was 20 cm across, 120 cm below datum and had a rounded base.

The stone alignment, feature 6, formed a semi-circle that ended just before the baulk line M 10/L 10 and was made up of single large rounded stones. Two other flattish angular stones were found in the L 10 baulk. These seem to have been part of the semi-circle though they did not abut against it and were slightly in from the line of it. Immediately below the stone semi-circle was a fire pit or hangi (Feature 7), which contained no stones and had apparently been filled in or levelled to form the base for the stone alignment, as it seemed to rest on a fairly consolidated flat area, and the stones had been placed neatly on the top. Post hole 5 marked the end of the consolidated area on the east side, and, as the end of the stones enclosed the north side of it, would seem to be part of the feature.

Feature 8 was a small heaped up collection of stones.

Feature 9 was part of a hangi pit dug from layer 4 into layer 5. It contained no stones in the area excavated, up to where it disappeared into the baulk.

Post hole 10 had a pointed base and was situated just inside the eastern baulk line in square L 10. It was 14 cm in diameter and ended 120 cm below datum, in layer 5. It was filled with a dark grey sand and was dug from layer 4.

Feature 11 consisted of a hangi pit containing numerous stones. This measured 60 cm across where it entered the east baulk of square L 10.

Feature 12 was a post or large stake hole at the south end of the east side of square L 10. Its point measured 120 cm below datum and it was rather funnel shaped at the top where it measured 20-25 cm across. The north side of the hole was higher than the south. It was at this large post hole that layer 6 ended (this hole dug into the top of the small dune bank menioned in layer 6) (Figs. 5, 6) and layer 5 had been removed so that it was not present immediately behind the post. Instead there was a patch of clean white sand which appeared to merge into a thin layer of layer 5 which thickened some 30 cm back. The interpretation of this post hole and the layering immediately behind it was complicated by the fact that the outer edge only of the hole appeared in the baulk and it was situated about 20 cm before the unexcavated baulk corner of the square where the excavation turned at right angles away from the hole.

Feature 13 was a hangi 60 cm across (north/south) with an area in the centre free of stones containing blackened greasy sand and charcoal of a more concentrated type than that of the surrounding layer. It was situated on the east side of the layer 3b pit and as the west side of the stones seemed to follow a straight line rather than a curved one it is possible that the pit had been cut through the edge of the hangi and the stones removed. An alternative is that the hangi might have had a straightish edge originally because the pit edge did not extend right to the edge of the stones, and because the sandy black of the hangi interior did not show in the very eroded edge of the pit.

Feature 14 consisted of a large stone heap and hangi pit interspersed with consolidated greasy sand and charcoal. Feature 15 situated beneath it and extending to the north-east and beyond the July test area was a compact layer of yellow sandy clay. It appeared to line the hangi and be compressed into, rather than be part of, layer 5. There were some shells scattered through it. A similar type of deposit was found at Site N30/5, square B, upper layer (Law 1972, p. 84).

Post hole 16 was a pointed post hole 120 cm below datum at its base and 14 cm in diameter. It was dug from layer 4 and filled with a grey black sand.

Feature 17 was a narrow slot dug through layer 5 into natural sand. The surrounding sand was rather stained or had organic material in it, forming a less dark patch around the slot than the fill material but had no definite edge. The slot was slightly angled towards post hole 16 and may have been a supporting wedge that rested against the larger post.

Feature 18 was a hangi pit filled with black greasy sand and protruding out of it from the bottom was a very large oval piece of whitish pumice.

Post hole 19 was 126 cm below datum at its base and 14 cm in diameter. Piled against the edge of the hole on the west side and showing in the baulk was a peaked yellow/white mound of sand which formed a lens within layer 4. It appears to be a pile of wind-blown sand that had accumulated against the post and become part of the layer.

Post hole 20 was close to but slightly north-west of hole 19. It was 14 cm across and about 114 cm below datum. Just below the surface was a stone that may have been placed to shore up the post.

Post hole 21, half of which remained in the baulk, was a shallow stake hole with the tip 94 cm below datum. It was 10 cm in diameter and was filled with grey sand.

Post hole 22, also a stake hole, had the point of the stake still in position. It had its origin in layer 4, but its pointed end was inserted in the ground and the wooden end remained *in situ* close to the position of the stone reel and file/saw in layer 5 (Fig. 19). It entered the ground at a slight angle, west to east.

Feature 23 was a hangi pit containing hangi stones. It was 60 cm across and the stones were intermixed with greasy black sand and charcoal, as were hangi 24 and 25. On the north-west side was an area free of stones. This stone-clear area was partly enclosed on the north side by an edging of stones.

Feature 24 was a very large hangi half of which remained in the north baulk. It measured 150 cm across and contained some very large stones. There were numerous other stones in this area of the square and the separation of hangi 23 and 24 was not as evident when excavation was being carried on.

Feature 25 was another very large hangi which occupied the south-west corner of square M 12. It reached about 1 m along the west and south baulk line. The stones were in a single layer rather than heaped, and rested on thick greasy material, although layer 4 in this part of the excavation had become less definite, greyer and sandier. No post holes were associated with hangi 23, 24 and 25.

Layer 5

This was a distinct cultural layer of clean, crisp coarse yellow sand of similar texture to the present beach sand. The layer contained the largest amount of cultural material and covered the whole site. No hangi were found, nor any evidence of fire pits. Numerous pieces of water-worn grey rubble pumice (later identified as Loisels pumice) were mixed with the sand, and, in several areas, the pumice formed concentrated deposits. Towards the west of the site, especially in the vicinity of baulks L 11 and M 11, pumice rubble formed almost the whole layer with a light mixture of sand and occasional shell and bone. It was amongst this rubbly pumice and sand that the stone reel (Figs. 17, 19), large sandstone file/saw (Figs. 19, 24) and bone lure shank were found.

The full significance of this grey pumice rubble (Loisels pumice) was not realised at the time of the excavation, although note was made of its presence and quantity in various parts of the site (see below, p. 69). It was found in smaller amounts in layer 4 but very little in layer 3b.

Midden and cultural material was scattered throughout layer 5 but one feature of the shell content was a number of concentrations of *Amphibola crenata* (mud snail) shells. There were two of these in square M 11 and a few more dispersed concentrations which had once been heaps. Less obvious and smaller in the number of shells, but possibly just as significant, were some aggregations of *Lunella smaragda* (cats-eye shells). As no fire pits were found in the layer these shellfish must have been eaten away from their cooking area. It is difficult to extract the uncooked animal from coil univalves such as *Amphibola* and *Lunella* without breaking the shells and most of these shells were whole. (It would be interesting to know what part the hot springs played, if any, to the importance of the site. Possibly the shellfish were boiled in the hot springs rather than cooked by other methods.)

No structural features were found in layer 5.

Layer 6

This consisted of pockets of yellow-grey sand containing some shell, bones, industrial moa bone and a few artifacts. In square L 10 it was thickest, forming a large pocket that butted up against a small dune formation in the original beach sand. It disappeared near the top of the rise where a post hole was cut from layer 4 down to the sand base (Figs. 5, 6). The layer was a mixture of coarse beach sand, similar in texture and composition to that of layer 5. It differed in its colour from layer 5 in that it was greyer and probably contained more organic material; charcoal or soil. Its colour was very similar to that of layer 3 and 3b but these layers were composed of a much finer textured sand, probably wind blown.

Layer 6 also appeared in small pockets in the north side of square M 11. Only two possible pieces of Loisels pumice were found in the layer, so it is fairly safe to assume that Loisels pumice was not a feature of the layer.

Test Areas

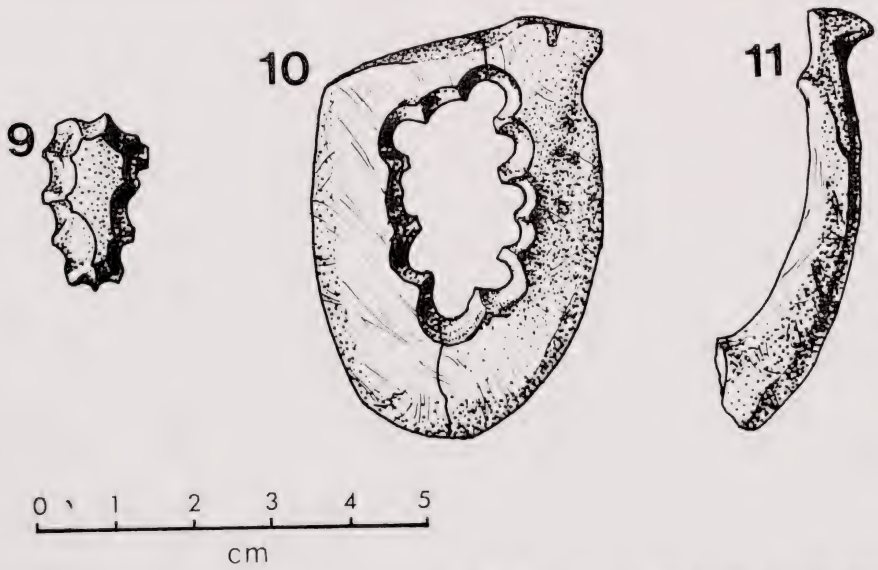
Of the two test areas (Fig. 3), the 50 cm square pit in square M 8 showed no evidence of cultural layers to a depth of 50 cm. The soil consisted of coarse grey sand and shelly grit.

The trial trench in square L 8 had a surface layer of material similar to that of the trial pit. Layer 2 was not present, possibly because, as previously suggested, it was a water-deposited layer and the trench was dug in the area where the ground rises towards the end of the beach to a ridge and the deposit would not settle there. Layer 4 was present, although not as thick as in the main excavation, and layer 5 was also thinning out. Layer 5 still contained some artifactual and midden material but none came from layer 4.

Material Culture

FISHING GEAR

Fishing equipment was represented mainly by fish-hooks and their manufacturing residue. No complete hooks were found. All layers produced evidence of fishing, though in layer 6 it was limited to a bone tab core and a piece of a completed one-piece hook. Trolling was indicated by one bone lure shank in layer 5 and one broken bone lure point in layer 4. Fish bone remains suggest that if nets were used they were probably small ones or hand-held drop nets. Apart from two doubtful pieces of worked pumice which might have been part of net floats, there is nothing to suggest the use of larger nets.



Figs. 9-11. Fish-hook manufacture and sizes. 9. AR 2940. 10. AR 2617. 11. AR 2900.

FISH-HOOKS AND THEIR MANUFACTURE

Bone tabs

Only one unused prepared tab was found and that is in the McCartney collection. The rest represent most degrees of working and completion. All tabs, except the McCartney one, show some centrally drilled areas. There is no evidence that tabs were prepared on the site, although there was a considerable number of small pieces of waste bone. The material from Mt Camel (N6/4) at Houhora, held in the Auckland Museum, seems to indicate that there, some large tabs were made from the wide flat area just below the joint-head of the bone. Some unfinished or broken tabs had been drilled out from this area and then filed smooth around the outside edge. No cut, drilled or broken joint articulating surfaces from moa or any other large animal were found at Hot Water Beach and this suggests that long bones without joints, and tabs, were brought to the site from elsewhere. This material was then split, filed or drilled on the site as required.

The most common remains of fish-hook manufacture are the waste bone pieces drilled from the interior of the tabs, that is the tab cores. An attempt to estimate the original size of the tabs and resulting fish-hooks has been made. Bone tab AR 2617 (Fig. 10) from square M 10, layer 5, has approximately the same proportions as the broken hook AR 2900 (Fig. 11) from the same square. Tab core AR 2940 (Fig. 9) from square L 10, layer 5, although not the original core, fits fairly neatly within the blank area of the tab. It appears that this size of core produced a hook of the approximate proportions of AR 2900. Length measurements were made of all the cores in the site. (Other measurements, width, thickness and number of drill holes were also made but did not appear as relevant as the length.) Tab core AR 2940 measured 2.2 cm in length and appeared to be about a median size for cores in layer 5.

Table 1 gives the number of cores in each layer, the size of the longest, the shortest and the median.

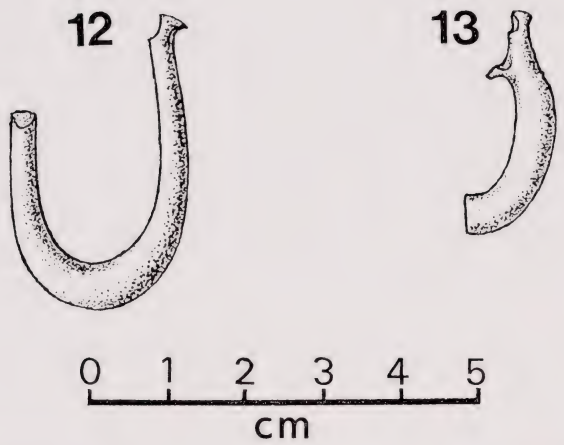
Table 1. Number and length of bone fish-hook cores.

LAYER	Number	Longest cm	Shortest cm	Median cm
3b	6	2.6	1.4	2.5
4	26	3.4	1.1	2.2
5	96	3.3	0.7	2.2
6	1	2.3	2.3	2.3

Any core over 3 cm long would probably produce a large hook for the site and anything under 1.5 cm a small hook, with 2.2 cm being a median. The hook shown in Fig. 11 would be a middle-sized hook for the site.

Layer 5 had 11 cores 1.5 cm long or smaller and 8 cores 3 cm or above. Layer 4 had one 1.5 cm or smaller and four 3 cm or above. Layer 3b had one core 1.5 cm long or smaller and none above 3 cm.

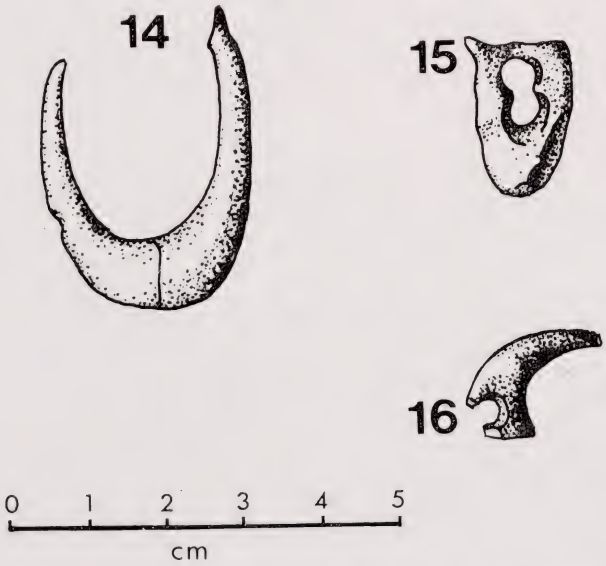
The decrease in cores from layer 5 up in the site probably indicates the increasing scarcity of moa bone. Some layer 3b cores may be intrusions from lower layers (see p. 29, Feature 3).



Figs. 12, 13. 12. Broken one-piece bone hook, Layer 5. 13. Broken shell hook, Layer 3b.

Fish-hooks

Layer 3b had very little in the way of fish-hook material. AR 2902 (Fig. 13) from square L 10, is a small shell hook made from the fresh water mussel (*Hyridella* sp.) (A. W. B. Powell, pers. comm.). It has an internal barb or lashing knob just below the small lashing head. The back or external portion has been ground concave below the lashing knob leaving a roughened area, the edges of which show a number of fine scratches or grooves. This roughened area, as well as being necessary to form the knob, would also help the cord to grip the lashing area. The hook has been broken at the base of the curve.



Figs. 14-16. 14. Broken bone hook, Layer 5. 15. Small fish-hook tab, Layer 3b. 16. Broken lure point, Layer 4.

One small complete thin drilled tab, AR 2917 (Fig. 15) was found in square L 11. This would have made a very small hook if it had been completed. Although it cannot be identitfied as to material it is small enough to have been formed from the tooth of an animal such as a seal or shark.

Both these fishing items in layer 3b appear rather different from the fish-hook material in the other two main cultural layers, and it is postulated that they represented a change in fishing styles or activities from the previous two layers and the need to make use of materials other than moa bone.

Portions of completed hooks were found in layer 3b. Two of these were from the fill of the pit in square L 11, but this fill could have contained intrusive material from layer 4. The other items were a small broken bone tab from square M 11 and a small piece of a completed one-piece bone hook from the same square.

Layer 4 contained five shank legs with heads, from one-piece fish-hooks, but no point ends. The broken tabs, tab cores and part fish-hooks are similar to those of layer 5 but fewer in number.

Layer 5 produced the most evidence for fish-hook manufacture and use. There were a number of broken tabs, partially completed hooks and several small portions of one-piece bone hooks with no heads or points. This layer also contained the shank legs with heads of 15 completed hooks and 4 shank legs with points. There were also two almost complete hooks.

One of these almost complete hooks, AR 2905/2906 (Fig. 14) is a one-piece bone hook from square M 10, broken across the base with the head snapped at an angle across the shoulder. The tip of the point is only slightly incurved. About 2 cm below the tip there is a shallow bait notch just where the outer edge starts to curve round to the base of the hook.

AR 2888 (Fig. 12) is a slender hook with a small head tilted back at an angle from the long axis of the shank. The tip of the point has been broken off. It is rather similar to AR 2905/2906 but slightly thinner at the base and it has no bait notch.

One other part hook, AR 2911, consists of a thick laterally flattened curved base which narrows, by a distinct shoulder, to a thin oval-sectioned leg (probably the shank leg) broken just below the head. The other leg continues up in the same thickness as the base but has been broken across the grain about one-third of the way up. Just before the break is a bait notch. This hook seems to be an attempt to overcome the weakness bone hooks have of breaking across the grain where the point of greatest stress comes, between the hook head and the point.

Although layer 6 appeared only in small pockets below layer 5, evidence for fishing was indicated by a tab core and part of a completed one-piece hook.

Lures

Layer 3b contained no evidence of trolling.

AR 2892 from layer 4 is a bone lure point with a single lashing hole (broken) and the point tip broken (Fig. 16). It has been blackened by fire. It was found in square L 11 in the part of layer 4 that covered the layer 5 Loisels rubble containing the lure shank.

One piece of point-shaped bone, AR 3369, was also found in layer 4. It has no suggestion of a lashing hole and no tip but it is thick at one end and tapers abruptly, showing a curve which appears abnormal for a one-piece fish-hook. Compared with AR 2892 it seems to conform more closely to a lure point than part of a one-piece hook but it shows no diagnostic features. An oval shaped piece of shell, AR 3314 (*Dosinia* sp.), was also found in this layer, filed flat along one side and along part of the other. It might have been part of an unfinished shell lure shank but this is doubtful.

A moa bone lure shank, AR 2881, together with several pieces of moa bone, some of which showed signs of working, were found in layer 5 in a pocket of Loisels pumice in square L 11. The bone shank measures 9.8 cm in length and 0.8 cm in thickness. At its widest part it is 1.9 cm across. It has a rounded head with a dorso-ventral hole for a line attachment and is rectangular in cross section. It has a step and shouldered tail lashing. Similar lures have been found at Pig Bay, Motutapu, N38/21 (Golson 1959b, p. 46 and Fig. 7, p. 42). I have a photograph of a similar one found at Sarah's Gully in 1959/60, possibly a surface find.

Discussion

The fishing equipment recorded from the site consists of two types in layers 4, 5 and 6. The most common is the oval one-piece bone hook defined by Crosby as the Opito, type 1 (Crosby 1966, p. 187). This was being made at the site from bone tabs that were probably prepared elsewhere. The other is the lure or trolling hook, Crosby's early dorso-ventral Tairua type lure shank, found in layer 5 (ibid., p. 115). This she couples with the deep curved bone lure point (ibid., p. 148) found in layer 4. She goes on to say that the chief area in the North Island for the distribution of the Opito 1 hooks coincides with the distribution of the Tairua type and the Whitipirorua sub-type of dorso-ventral trolling hooks. This appears to be so for Hot Water Beach. Thus fishing material from layers 4, 5 and 6 belongs to part of a homogeneous and well established tradition in the Coromandel area when seen within the wider context of other sites in the North Island.

If there is any indication of change, it comes in layer 3b where the Opito 1 hooks are hardly if at all represented. (Most of the Opito type 1 pieces came from the fill of the 3b pit and this fill could have in part come from the disturbance of lower layers for fill material and not be part of the layer 3b occupation).

Crosby (1966, p. 210) states that, "For the period when the *Opito* 1 type cease to be the common form of small hook in Coromandel fewer fish-hooks were recorded but those that were noted exhibit influence from Northland and also from the Bay of Plenty and the East Coast (*Hahei* and Portland types)."

The first part of that statement would apply to layer 3b although what outside influences, if any, the shell hook and the small tab outline show needs further investigation.

ORNAMENTS

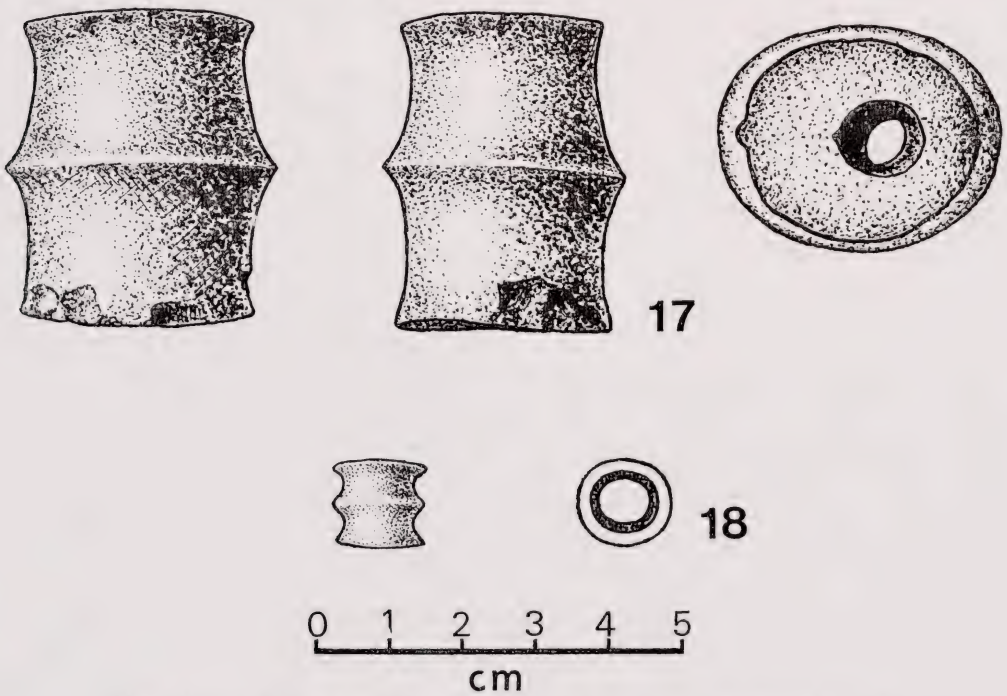
A number of artifacts, presumed to be ornaments, were found in the site. Similar ornaments were found in the Opito midden, N40/3, layer 4 (see below, p. 70).

It is common practice in New Zealand to use the term "necklace" units to describe items of presumed personal adornment which have been drilled to suggest stringing. This is a reasonable assumption but it is interesting to note that Banks states (Beaglehole 1962, p. 17):

> Besides these they hung to them by strings many very different thing(s), often chissels or bodkins made of a kind of green talk which they value much, the nails and teeth also of their deceased relations, dogs teeth, and in short every thing they could get which was either valuable or ornamental. Besides these the Women wore sometimes Bracelets and anclets made of the Bones of Birds, shells, &c. . . .

Banks also describes other types of ornamentation including various items made of wood, feathers, etc, which would be unlikely to survive in an archaeological context.

Evidence for the manufacture of ornaments on the site is suggested by a partly completed bone or ivory reel and an incomplete bird bone tube unit. Ornament preparation of a time consuming nature appeared part of the economic activities of the groups that occupied the site, especially the layer 5 occupants. The items were in sufficient quantities to suggest that they were a significant enough part of their social organisation to warrant the time spent on them.



Figs. 17, 18. 17. Stone reel from Layer 5. 18. Dentalium reel unit, Layer 5.

Stone reel

A stone reel, AR 2879 (Figs. 17, 19) was found in square L 11, layer 5, in the L 11/M 11 baulk. It measures 4.46 cm in length, 3.6 cm in width and weighs 73.3 g. It is made of serpentine, but the source has not been established (R. N. Brothers, pers. comm., E. J. Searle, pers. comm.). A personal inspection of the reels held in the Canterbury Museum (without the Hot Water Beach reel) produced only one which in appearance had the same type of stone and that was one from a site near the mouth of the Rakaia River, South Island (Trotter 1972, pp. 137-138). Trotter suggests Carbon 14 dates of 585 ± 64 and 518 ± 80 B.P. for the site (ibid., p. 135). The Rakaia reel is not of the same shape and is smaller than the Hot Water Beach one.

Fig. 19. Stone reel, abrader file and wooden peg *in situ* Baulk L 11, Layer 5.

The Hot Water Beach reel is rather oval in cross section and has three raised ridges, one in the centre and one at either end. The central ridge is about 0.2 cm wider than the end ones. Considerable damage by mishandling, age or deliberate modification has caused numerous small flakes to be knocked from the raised end ridges. These chips occurred after the completion and polishing of the reel.

The reel was found during the removal of the final baulks and was in the coarse yellow layer 5 sand. This was part of an area where there was a considerable amount of Loisels pumice which extended into square L 11 as a thick pocket and in which several pieces of industrial moa bone and the bone lure shank were found. Closely associated with the reel was a large flat sandstone abrader/saw AR 2880 (Figs. 24, 19), the blade of which was stuck down into the pumice rubble which formed part of layer 5, north of and at an angle almost covering the reel. Figure 19 also shows the end of a wooden stake inserted in the sand but this had its origin in layer 4.

Bone or ivory reels

Two of these are held in the McCartney collection and come from layer 5. One is centrally perforated and has three external ridges. It is 1.2 cm long and 1.1 cm wide. At one end the drilled hole is angled, almost piercing the side of the reel. The hole at the other end is correctly placed. The central ridge has an irregular curve to it. It is possible that this was deliberately offset to counteract the weakness in the central drill hole but the other reel shows the same irregularity. This second reel is in the process of manufacture. It is larger than the first, being 1.6 cm long and 1.4 cm wide and slightly oval in shape. The end ridges are more pronounced and the two end surfaces are flattened and show filing striations in the bone surfaces. There is no sign of drilling from either end. One end has a large chip off the side and the area seems darkened as if charred. It is possible that this chip led to its abandonment during manufacture.

Dentalium shell units

Three units of the large fossil *Dentalium nanum* shells were found in layer 5. Two are in the McCartney collection and the other, AR 2512, is held in the Auckland Museum collection (Fig. 18). AR 2512 is 1.1 cm long and 1.2 cm wide and has, like the other reels, three raised ridges. The other two are similar but one is shorter and wider, being 0.9 cm long and 1.2 cm wide. The other is 1.1 x 1.1 cm in size. It is possible that these three units may have come from the same shell, as they appear to grade slightly down in width.

Dentalium units of the small size were also found in the excavation. AR 3196 was a small shell tube filed flat at both ends. It measured 0.6 cm in length and 0.3 cm in width. It was found in square M 10, layer 5, as was AR 2915. This was a longer piece, 1.6 cm and 0.2 cm across. It had also been filed flat at either end.

Bird bone tube units

Four of these were found in layer 5. AR 3517 came from L 11 and is 1.1 cm long by 0.4 cm across. AR 3196, square M 10, is 1.2 cm by 0.4 cm wide, and AR 2903, from L 10, is 1.0 cm long and 0.4 cm wide. It is a darker colour than the others.

AR 2909 was found in square M 11, in the M 10/M 11 baulk. It is 1.3 cm long and 0.4 cm across. This unit was in the process of manufacture and showed several shallow grooves across the bone before the final deeper circular groove. It had been been snapped, leaving the broken edge.

Comb fragment (?)

A thin flat piece of bone, AR 3015, 1.5 cm wide, 3.0 cm long and between 0.2 and 0.3 cm thick was found in square L 10, layer 5, in the L 10/M 10 baulk. It has been flattened on both sides to a very smooth surface. One edge has been filed straight and then turns a corner to rise to a rounded knob which drops on the other side to a flat edge where the bone is snapped along the grain. The fragment can be fitted into the type B style as defined by Shawcross (1964, Fig. 5, p. 389). However, because of its fragmentary nature, lack of teeth and other diagnostic features, other than the raised knob, the nature of this artifact remains in doubt.

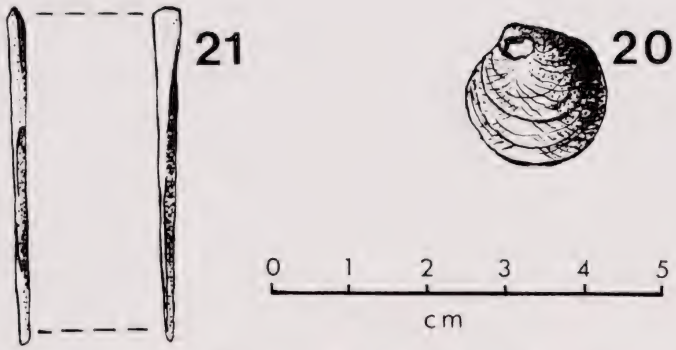
Tattooing chisel (?)

A possible tattooing chisel, AR 2894, was found in square M 11, layer 3b. This consists of a flat sliver of bone 0.7 cm wide across the squared off top and widening out to 0.9 cm just above the break where the teeth points may have been, but no indication of these teeth shows on the bone above the break. It is 2.6 cm long. There is a circular hole 0.3 cm in diameter situated centrally and 0.5 cm below the square top. There is a longitudinal break dividing the piece into two parts through the hole, possibly of later origin than the break above the "teeth". In size, shape and general appearance it conforms to several of the tattooing chisels held at the Auckland Museum, except for the missing teeth.

Artificially pierced shells

These have no context in the site as they were found amongst the disturbed material removed from M 10 at the beginning of the excavation to establish the boundaries of the fossicked area. This material was sieved and bagged for later checking. A considerable amount of artifactual material came from these bags and amongst it, in one bag, were five shells of *Divaricella huttoniana*. Each shell had a hole at the base of the central hinge (Fig. 20). These perforations were examined and it was established that they are too irregular to have been caused by a shell borer and could be presumed to be artificially made (W. Cernohorsky, pers. comm.).

No other shells of this species were found in the site and as it is not a known food species it was probably picked up from beach debris. It can be found on beaches in the area. Morton and Millar (1968, p. 464) state that it is an uncommon bivalve washed up on ocean beaches, distinguished by its snow-white shell, and chevron-patterned sculpture. The shells vary in size from 1.7 cm to 2.4 cm in length. They are fairly chipped round the edges and very fragile. One shell has a reddish deposit along one side and over the interior which, under the microscope, appears as a very fine-grained deposit compared with the sand grains also adhering to it. The material does not stain the shell surface and is probably kokowai.



Figs. 20, 21. 20. Artificially pierced shell *Divaricella huttoniana* from disturbed material. 21. Worked and fashioned bone artifact, Layer 5.

Because of the thinning out of the cultural layer 3b in the M 10 area these pierced shells probably were from either layer 4 or layer 5. As layer 4 was black and fairly greasy and the shells have clean sand adhering to them, and as no other ornaments were found in layer 4, it is very likely that these shells were part of the layer 5 deposits.

SHELL ARTIFACTS

Shells showing use were found in layers 3b, 4 and 5 and this use was of two types. One type appeared to be pressure flaking along the edge of the shell as if used for scraping, and the other type produced a flat ground edge (or else a flat ground edge was made deliberately for some unknown function).

Two *Amphidesma australe* (pipi) shells from layer 3b and three pieces of either *Amphidesma australe* or *A. subtriangulatum* shell (tuatua) showed pressured flaked edges.

In layer 4 one piece of elongated oval shell, shaped from a valve of *Dosinia* sp., had one end and side artificially flattened. It may possibly be a scraper, or more doubtfully, an unfinished shell lure. One *Amphidesma australe* shell with pressure flaked edges and two pieces of flat-edged shell were also found.

Three *Amphidesma australe* shells with pressure flaked edges and two pieces with flattened edges were found in layer 5.

BONE ARTIFACTS AND WORKED BONE

Two small pieces of worked bone were found in layer 3b. One had been sharpened to a point by a cut on one side of the bone. It was blackened by fire. The other is a piece of moa bone smoothed on one side. It was found, together with broken fish hook parts, in the fill of the pit in squares L 11/M 11.

The point of a large needle made from a hollow bone, probably bird, was found in layer 4, square L 10. The point is formed by cutting the bone diagonally across the end and then smoothing it. The bone is blackened as if charred, as are several

other items from this square. Two other pieces similar to it but with no ends were also found but could not be matched to the point. Layer 4 contained several other pieces of drilled, filed and worked bone. The crown of a tooth, probably of a sea mammal, split down the middle, was also found. One side has a notch in it and the enamel is chipped, possibly by pressure flaking.

The largest amount of worked bone and bone artifacts was in layer 5.

One complete slender bone needle measuring 7.1 cm in length and about 0.15 cm in width is in the McCartney collection. It is pointed rather than rounded at the apex above the eyelet and has a very small eyelet hole. It is slightly flattened on either side, probably following the structure of the original bone, and is highly polished.

AR 2908 from square M 11 is an unfinished needle which is slightly curved laterally and rectangular in cross-section with an off-centre uncompleted eyelet hole. It measures 6.4 cm long and is 0.3 cm wide. The end has been roughly pointed by cut facets but it has not been polished. The eyelet portion of a large needle, AR 2918, came from square L 10. It is 2.8 cm in length to the break, about 0.8 cm wide and 0.4 cm thick. It is slightly tapered at the eyelet end but rounded above it. The eyelet has been drilled from both sides and is slightly off-centre but this has not weakened it. It is slightly rounded on one surface and flattened on the other. The needle is of a dark brown colour and is highly polished.

Two other artifacts in bone that appear to have been completed are AR 2891 and AR 3246, both from square M 10. AR 2891 (Fig. 21) is a sliver of bone, needle-like in shape but with a flattened portion at one end and a point at the other. The flattened end has a bifacial bevel to it. It is 4.2 cm long, 0.3 cm at the flattened end and tapers to a point at the other. Although the shaft shows cutting facets down it, these have been polished. There is no suggestion of an eyelet hole. Although its purpose is unknown, it could welll have been a useful instrument for removing univalve shellfish from their shell.

The other artifact, AR 3246, is an oval bone flake (rather like a flattened tuatua shell), possibly some kind of a scraper. It has been filed flat along the "back" edge and the end edges have rounded but angular facets. The "front" edge is naturally sharp, as a result of the flaking. One surface is flat following the bone structure and the other is flattish but showed some filing or polishing. It is 3.3 cm in length, 1.6 cm wide and about 0.4 cm thick. A bone awl, held in the McCartney collection, also came from layer 5. This has been made from the joint and shaft of a limb bone of an animal, probably a dog. The shaft is cut diagonally across and the point formed into a short protrusion with a rounded point. It is 6.4 cm long, the width across the top of the joint is 1.8 cm and the width at the cut end of the shaft is 1.0 cm.

Other worked bone was found in the layer but it was all uncompleted. A long shaft of hollow bone has been cut at one end by grooving and breaking, the other end just being snapped. It is 10.5 cm long and about 1.3 cm wide. There are also several pieces of moa bone showing either grooving, cutting, drilling or smoothing.

AR 3417 from square M 11 is the distal end of the right humerus of *Nestor meridionalis* (kaka). This has a groove cut across the base of the joint and then another

groove which allowed the breaking of the shaft at this point. This piece of worked bone is the one mentioned on p. 62.

In layer 6, square M 11, a moa bone splinter, 6.1 cm in length and 1.7 cm wide, was found. It was pointed at both ends by breaking and just below the widest part is a drill hole half of which has broken.

ADZES

Seven adzes and roughouts were found in the site (one small roughout was collected on a later visit as a surface find). The adzes and roughouts in the site appear to have been made by flaking and then polishing (if a completed adze). Hammer-dressing only occurred occasionally. Adzes were made from cores rather than flakes (see Nicholls 1964, p. 32).

Polishing appears to have been kept to the minimum required for efficiency. There is nothing in the adze assemblage to suggest anything other than the Archaic style although the carbon dates for layer 4 might appear rather late. Certainly the one roughout from layer 3b appears to reflect continuity in adze manufacture although other evidence, such as fish-hooks and decrease in moa bone, might indicate some technological change from layers 4 and 5 to layer 3b.

AR 2921 is a roughout from layer 3b. Its length is 5.6 cm, width at the blade 3.8 cm and it is 2.0 cm thick. There is some indication that it could have been slightly sub-triangular if it had been completed. It is made from a medium-grained grey-black stone which is probably basalt.

Four specimens came from layer 4. AR 2564 is a triangular-shaped roughout similar to a Duff Type 4 B (Duff 1956, Fig. 43) at the blade end but tapering rather abruptly behind the apex and possibly broken at the butt end. Its length is 8.2 cm and it measures 5.6 cm at the blade edge, tapering to 2.6 cm at the butt end. It shows no sign of polishing or hammer dressing. There is a small patch of orange-brown weathered cortex on one side near the butt end. It was found during the preliminary test dig.

AR 3284 is the rectangular butt end of what appears to be a small adze or the corner of a butt of a larger adze. It is a greeny-black colour and is a fine-grained stone. One side shows a small amount of grinding and there has been some possible polishing of the butt. The front surface shows a flake scar from the butt down and one edge has several small flakes removed possibly by pressure flaking. It may have been broken and the piece used as a working flake. It measures 3 cm down, is 2.8 cm wide at the break and 1.8 cm at the butt and is about 1.2 cm thick.

Two adze roughouts found in the McCartney excavation are assigned to layer 4. They were found at the top of a greasy yellow sand layer above layer 5 and below the black greasy layer 4. By their position in the site, they were associated with the yellow sandy clay (feature 15, Fig. 8). This clay layer thickened nearer the beach, being between 5-9 cm thick in the preliminary test excavation and would have continued on into the McCartney excavation. The larger of the two specimens is 8.2 cm in length, 3.4 cm wide and 1.9 cm thick. It is similar to the Duff Type 3 B

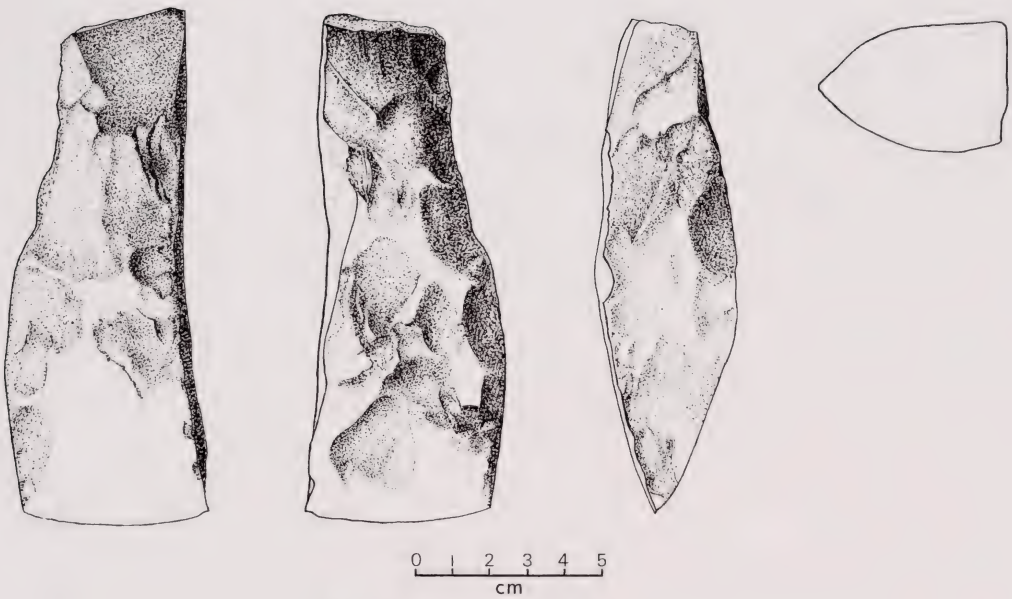


Fig. 22. Side hafted adze, Layer 5.

(triangular, apex down) (Duff 1956, Fig. 38) but shorter and thicker. It is made from a grey-black fine-grained stone and is polished on the bevel and partially polished on the front surface. There are two large chips knocked off the bevel edge. It shows no hammer dressing.

The smaller roughout is almost triangular, both from bevel to butt and from side to side. The blade has large flakes taken from both sides and one side of the adze is flaked flat while the other narrows to a more rounded ridge. It is more the shape of an incipient side hafted adze, but had probably been broken in half during manufacture. It is very much a "roughout". Its length is 6.6 cm, width at blade 4.1 cm and thickness at the broken end 2.8 cm. It is made from a greyish-black medium-grained stone, and appears to be slightly sand blasted.

Two complete adzes were found in layer 5. AR 2521 was found by Mrs McCartney during her excavation in the coarse yellow sand of layer 5 together with the bone reels and other artifacts. It is a "side hafted" adze of the Duff Type 5 (Duff 1956, Fig. 48), 13 cm long with a blade width of 4.9 cm (Fig. 22). It is 4.7 cm at its thickest part across the broad flat hafting surface. The upper part of the butt, where it narrows, has been hammer dressed, no doubt to remove the sharp flaking edges to prevent wear on the lashing. The adze has been formed by flaking and then the two sides of the blade polished. The rest shows irregular grinding and polishing facets over the ridges of the flaking scars. On one side near the butt is a small area of creamy-brown weathered cortex.

AR 2920 (Fig. 23) is a small bluey-black adze from square M 11, layer 5. It is roughly quadrangular in cross-section, 5 cm long and the width of the blade is 2.9 cm.

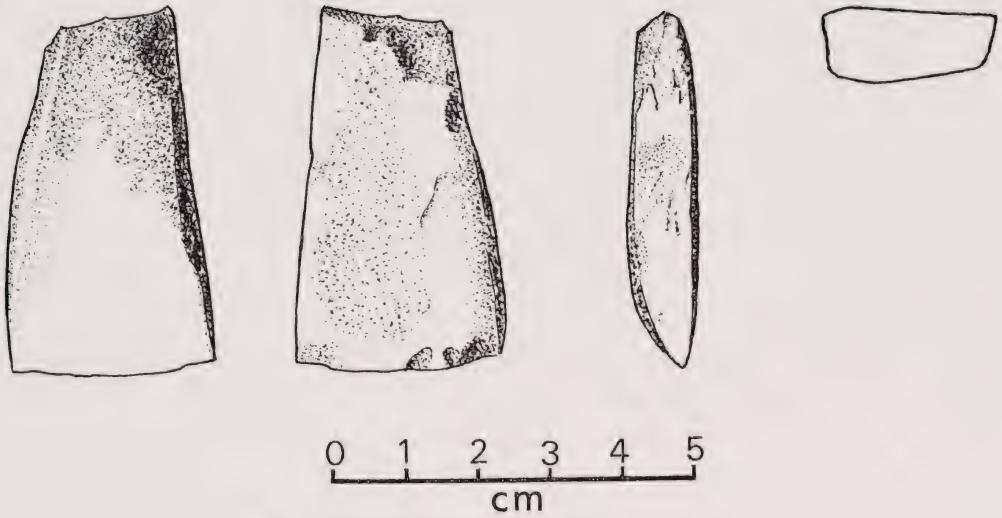


Fig. 23. Small polished adze from Layer 5.

The adze narrows down to a butt end which is about one-third of the width of the blade and ends abruptly, showing a sharp single flake scar which could have been accidental or deliberate.

The blade has a rather curved bevel but two small side facets emphasise the actual blade angle across the curve. The adze has been polished all over except for the poll and where flake scars have been too deep to erase. A series of small chips about 2-3 mm in size has been broken off the front of the blade. Although the adze is a small one it is not clear if it is a flake or a core adze.

One small partially polished adze, AR 4109, was collected as a surface find later. This was a core that has been flaked to shape and then polished at the bevel edge, but three chips have been knocked from the edge after polishing. The front surface also has been slightly polished up to where the butt has been modified by having a large flake struck from one side, thus forming an irregular shoulder, probably for hafting. The butt end is much narrower than the blade. It measures 6.2 cm in length, the blade is 3.3 cm wide and the thickness at the butt end is 1.6 cm. From the blade it tapers more abruptly towards the butt on one side than the other.

ABRADERS

The central portion of a lenticular file with part of one side broken away was found in layer 3b.

Layer 4 contained two tips from lenticular files and one shouldered lenticular file with the tip broken. A corner of a small broken hoanga (grindstone) with one surface worn was also found.

AR 2880 (Fig. 24) was found in association with the stone reel in layer 5, square L-11. It is 21.5 cm long, 7.5 cm wide at the widest point and about 1.4 cm thick. It has been made from a flat piece of coarse-grained stone, split along a cleavage plane.

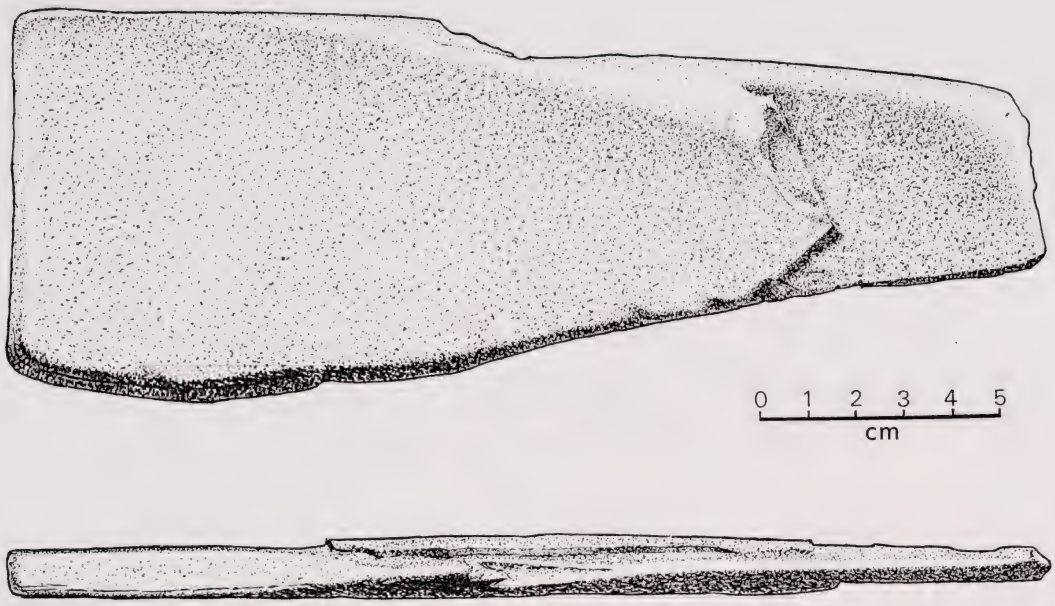


Fig. 24. Abrader saw from Layer 5.

It is narrower at one end than the other. One side has been hammer dressed along the edge, either to modify an uneven area or to provide a rough gripping surface. The working edge is worn smooth on either side for three-quarters of its length to form a long narrow smooth sawing edge that extends up the blade to almost 3 cm in places on either side of the edge. The apex of the edge is slightly flattened. The working surface extends round the narrow end of the blade. Because of its association with the stone reel and the fact that bone reels were being manufactured in the layer, it may well have been one of the instruments used in their manufacture.

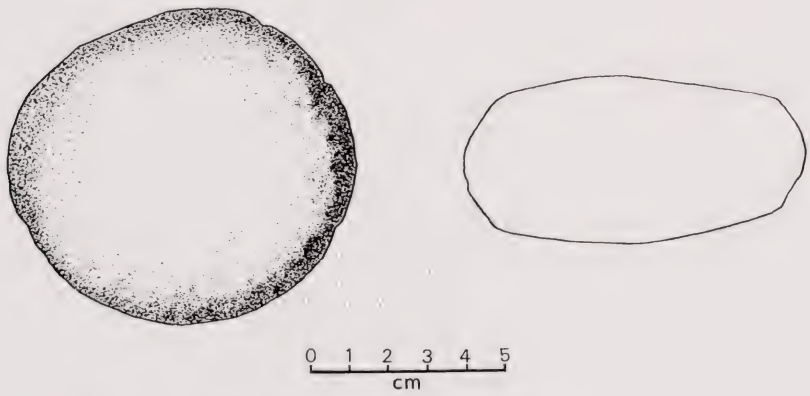


Fig. 25. Round abrader from Layer 5.

AR 2895 from square M 12, layer 5, is a circular to ovoid pinkish coarse-grained stone, flattened top and bottom (Fig. 25). It is 9 cm in diameter at its widest part and 7.5 cm across its narrowest and is 4.3 cm thick. The sides are roughened or bruised, with the bruising more obvious at the ends of the long side, suggesting that a hammer stone may have been one of its uses, but the soft nature of the material would preclude its use on any hard material. The upper and lower flat surfaces are considerably smoother than the rest of the stone and in places they are almost polished. It fits easily into the hand and would be very suitable as an abrader to smooth over and flatten moa bone fish-hook tabs amongst other things.

Four tips of sandstone files, lenticular but with flattened sides, were found in layer 5. There was also the broken end of a rather pointed file, one larger file complete except for the tip being broken off and several "interior" pieces. Three lumps of roundish coarse sandstone were interpreted as possible roughouts for file preparation (see Law 1970, pp. 84-85). One squared corner of sandstone or similar material rough on one side and having part of a smooth saucer-shaped depression indicating use as a hoanga, was also found in layer 5.

WORKED PUMICE

Although there was a lot of pumice throughout the site, very little appeared to have been used.

Layer 3b had only one possible flattened piece of pumice that might have been an abrader, but it is doubtful.

Two pieces from layer 4 showed use. One is an oval piece about 8 x 4 cm with a well defined groove along a narrow side as if it had been rubbed up and down a long thin object. On one of its flattish surfaces is a small oval V-shaped hole, possibly made by smoothing off a point. AR 3343b is a square corner of grey glassy abrasive pumice about 5.7 cm long which has been shaped and broken diagonally across the corner. The sides have been angled in to make it narrower at the "top" than the "base". Centrally placed along the diagonal break is the remaining half of a hole drilled from either side. On the "base" surface are several pointed indentations. The sharp abrasive nature of the material does not suggest its use as a net float.

Two pieces of flattened pumice, probably of natural origin, were found in layer 5.

STONE POINTS AND DRILLS

There is a wide variety of points ranging from very small (1.4 cm) to large (8.9 cm). They have been divided, according to material, into siliceous and basalt, and according to cross-section into sub-categories of triangular and rectangular. The triangular points in most cases require considerably more flaking and fashioning than the rectangular ones. The triangular points were more common (Table 2) and possibly economically more important or more efficient, but the rectangular ones may have been used for a special purpose.

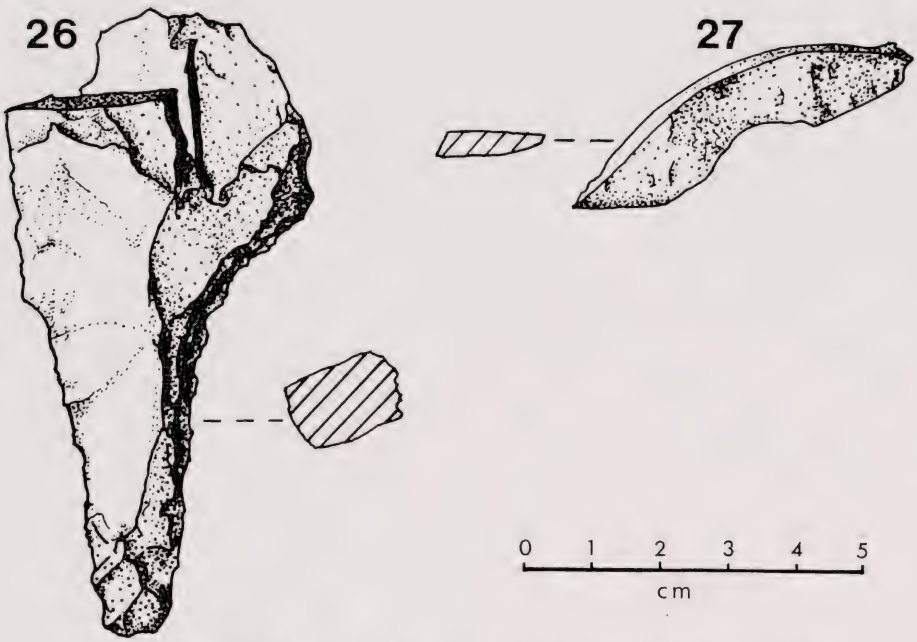
Table 2. Number, distribution and size of stone points, N44/69.

	Layer 3b	Layer 4	Layer 5
Siliceous			
Cross section			
Triangular	7	13	27
Rectangular	2	5	11
Basalt			
Cross section			
Triangular	—	2	—
Rectangular	—	2	2
Total:	9	22	40
Siliceous			
Broken, used			
Tips	3	5	18
Bases	1	2	12
Unfinished	3	4	21
Total:	7	11	51
Total All points:	16	33	91
Sizes (length)	(cm)	(cm)	(cm)
Maximum	5.2	5.3	5.0
Minimum	3.0	1.8	1.4
Median	3.3 — 3.5	3.2	3.3

The methods of manufacture of siliceous points are similar to those described by Nicholls (1964, p. 30) and Law (1972, pp. 92-93). Broken drill points were very common and all layers except layer 6 produced a number of unfinished or discarded points. The 21 unfinished points from layer 5 suggests that drilling activity and the need for a good supply were important at that time.

Within the siliceous category the quartz points generally were smaller than the other siliceous ones, e.g. jasper, carnelian and fossilised wood. This may have been the result of the nature of the material and its working qualities rather than choice. The smallest point was from layer 5. It was of quartz, 1.4 cm long with a very fine point which would have been more appropriate for drilling eyelet holes in needles than for fish-hook manufacture.

Basalt points were also present in the site. Two from layer 4 were similar in form to the triangular siliceous points. The larger basalt points, so called "hand-held" types, are not included in Table 2. One, AR 3063, from layer 3b, may have been used as an abrader rather than a drill point or may have served a dual purpose. It is a long triangular basalt flake with a tapering shaft and a round end. The back side is



Figs. 26, 27. 26. Basalt point, Layer 4. 27. Basalt flake knife, Layer 5.

flat with two sharp edge angles but the front is rather smooth and rounded, showing signs of rubbing or wear. It measures 7 cm in length.

One "hand-held" basalt point was found in layer 4 (Fig. 26) and two in layer 5.

BASALT FLAKE "KNIFE"

A crescent-shaped basalt flake, AR 2949, was found in layer 5, square L 10 (Fig. 27). It is 5.2 cm long and 1.2 cm at its widest part. The rounded "back" is smooth, flat and partially polished and both sides have had the rough areas smoothed by polishing. One end has been flattened by polishing into a blade that ends in a point, giving it a rather scalpel-like appearance. Although one or two of the basalt flakes have secondary flakes removed from them, this is the only shaped basalt tool apart from the adzes and basalt drill points.

STONE FLAKES

A large number of stone flakes were recovered in all the main cultural layers in the site. These were separated into obsidian, basalt and siliceous material for analysis. They were then divided into two groupings, those with definite evidence of use wear (used) and those without such evidence (waste?).

Flake material such as that found at Hot Water Beach seems to form an essential part of the basic technology in New Zealand, either as waste that occurs from the making of core tools, such as adzes, or as flake tools such as knives, points and

scrapers. These tools reflect a wide range of activities and because of this considerable attention has been given to the flake material. Work is still progressing on the analysis. However, some preliminary patterns are already in evidence.

Obsidian

The obsidian was divided into two categories by observation, green being classed as very probably from the Mayor Island source and the rest from "other sources". These two groupings were then sub-divided into used and waste(?). Analysis was done on these major groupings using figures for both the number of pieces and weight.

As the excavated volume of the layers was not equal, a technique for assessing the volume of each layer was adopted. The layer thickness at 50 cm intervals for each baulk wall was taken from the plan drawings. These were then averaged and, using the excavated area of each square, a cubic measure or volume was estimated. Estimates for layers 1, 2 and 3a, where the sterile nature of the soil indicated that they were not cultural deposits and the erratic cultural layer 6, are not considered. Layer 3b averaged 17 cm in depth over the whole site, layer 4, 14 cm, and layer 5, 15.4 cm. The total area excavated was 26.5 m. The average cubic content of the cultural layers was as follows:

Layer 3b = 4.505 m^3, 36.6% of volume
Layer 4 = 3.710 m^3, 30.2% of volume
Layer 5 = 4.081 m^3, 33.2% of volume.

The significance of differences for weight or number of pieces in samples was estimated by calculating the appropriate chi-square values (Snedecor and Cochran 1967, pp. 215-218, 228-236). In general the results are reported only as probably significant, significant and very significant, indicating conventional 5%, 1% and .01% levels of probability respectively.

The raw scores, uncorrected for volume (Tables 3, 4) were calculated first and the layer patterns established. Then the figures were recalculated having been corrected for volume. Patterns and levels of significance were then compared. It was found that correcting for volume of layers sometimes changed the patterns of distribution and the significance of the results.

Table 3. Preliminary analysis of obsidian in layers, by number, N44/69

	LAYER	Mayor Island	Other sources	Total
Waste (?) pieces				
	3b	56	90	146
	4	92	183	275
	5	165	321	486
	6	—	—	—
		313	549	907
Used pieces				
	3b	38	47	85
	4	37	35	72
	5	66	52	118
	6	—	1*	1*
		141	135*	276*

* For the purposes of analysis only layers 3b, 4 and 5 were processed, so that layer 6 material was not included in the totals.

Table 4. Preliminary analysis of obsidian in layers, by weight, N44/69.

	LAYER	Mayor Island	Other sources	Total
		g	g	g
Waste (?) pieces				
	3b	144.7	232.2	376.9
	4	190.3	723.6	913.9
	5	290.5	1359.7	1650.2
	6	—	—	—
		625.5	2315.5	2941.0
Used pieces				
	3b	391.1	446.9	838.0
	4	240.1	363.7	603.8
	5	730.9	649.0	1379.9
	6	—	21.7*	21.7*
		1362.1	1481.3*	2843.4*

* For the purposes of analysis only layers 3b, 4 and 5 were processed, so that layer 6 material was not included in the totals.

It was concluded that inter-layer statistical comparisons not corrected for volume can at times give misleading results. For example, a chi-square value calculated from uncorrected waste Mayor Island obsidian by weight showed that there was a probable significant difference between layers in which layer 3b had more obsidian by weight than expected, layer 4, slightly less than expected and layer 5 less than expected. When corrected for volume there was a very significant difference between layers and the distribution pattern altered. Layer 3b changed to less than expected, but layers 4 and 5 to more than expected. The distribution pattern for the layer totals by weight also changed in a similar fashion.

The following discussion relates mainly to the obsidian results which have been corrected for volume except where specified.

There is a very significant difference between the total number of waste obsidian pieces in the layers. The contribution to the difference comes from layers 3b and 5, with layer 4 exhibiting results very much as expected. The distribution pattern shows layer 3b has fewer pieces than expected and layer 5 more than expected.

When Mayor Island is compared with "other sources", the very significant difference between layers remains, as does the pattern of distribution, with layer 3b less, layer 4 as expected, and layer 5 more. If the source totals, corrected and uncorrected for volume, are compared, it is the category of "other sources" that shows greater degree of change.

The significant excess of waste obsidian in the "other sources" category could well be accounted for by the fact that much of it had an irregular cortex or crust which required removal before the flaking quality obsidian could be obtained. Removal of this cortex occurred at the site (out of a total of 728 "other source" pieces, 279 showed some cortex). Mayor Island obsidian, being mainly mined, showed an insignificant portion of such material.

Used pieces of obsidian by number showed only a probably significant difference between layers but the overall distribution between layers does change. This is especially evident in layer 4 where there is less than expected of the used pieces, the loss being evenly distributed between Mayor Island and "other sources".

There is a significant difference between layers in the pieces of used Mayor Island obsidian by number but no significant difference shows in those from "other sources". It is the Mayor Island layer 5 material that provides most of the difference, something not true for obsidian from the "other sources" in that layer.

It is interesting to note that there were 449 "other sources" pieces (used and waste) without cortex and, out of that number, only 69 pieces showed use wear. Yet of the 428 Mayor Island pieces without cortex there were 125 used pieces, almost double the number.

Generally speaking, layer 3b possesses fewer Mayor Island pieces than expected, but the differences between the observed and expected in the "other sources" material is less, indicating an increasing emphasis on the use of obsidian from "other sources" at the expense of the Mayor Island material. The pattern of pieces of obsidian by number shows there was very significantly more obsidian in total in layer 5 than in the other two layers. It also shows that more Mayor Island material was used in layer 5, whereas the layer 4 results were more or less as expected and the layer 3b results indicated an increasing preference (?) for using material from "other sources". Thus there appeared to be a cultural or mechanical preference for using Mayor Island obsidian throughout the sequence although it is evident in layer 3b that a change to "other sources" was occurring.

The results for waste obsidian by weight, when corrected for volume, follow the same pattern as those by number of waste pieces. Layer 3b has less than expected, layer 4 is as expected and layer 5 has more than expected.

There was also a very significant difference between layers when analysed using the figures for total weight. When separated, the Mayor Island material also exhibited a very significant difference between layers, while "other source" material provided a significant level of difference. While the contrast by weight between layer 3b and layer 5 remains the same as that for the number of pieces, the overall pattern changes, with layer 3b having less and layers 4 and 5 both having more waste by weight than expected. The layer 4 change to more than expected, evident throughout the waste material, though not statistically significant, does seem to indicate the beginning of a trend that is evident in the significant difference between layers 3b and 5. As might be expected from the previous observations, it is the material from the "other sources" which accounts for most of the difference.

The totals for used obsidian by weight exhibit a very significant difference between layers, whereas the used pieces, analysed by number, indicated only a probably significant difference. Again the distribution pattern is one of layer 3b less and layer 5 more than expected. However, in layer 4 the amount by weight is considerably less than expected, with more of the contribution coming from the Mayor Island material

than the material from "other sources". Thus although the number of used pieces in layer 4 is about as expected, this does not hold for their weight. It would appear that the average size of the pieces must therefore be smaller.

Comparisons between the obsidian materials in layers 3b and 5 raises the problem as to whether the activities associated with the layer 5 occupation required more use of obsidian or whether obsidian was more easily available at the earlier end of the site's history. Was the change one in economic activities or was obsidian more difficult to obtain when layer 3b was formed? Was it more difficult, for example, because of warfare, to draw on the Mayor Island source, hence a favouring of the use of "other sources" in the later layer? This hardly seems to be the whole explanation, as the "other sources" category is likely to include a high percentage of readily available obsidian from numerous locations along the Coromandel coast (Ward 1973). Therefore, while the change in preference for source material might have a political explanation, it would seem that the reduction in quantity is more in keeping with the economic changes indicated by midden analysis, i.e. changes in economic activities in which the obsidian was used.

Figures, uncorrected for the volume of the layers, when divided into used and waste groupings show that the used Mayor Island material by weight is, in all cases, greater than the waste material by weight. The material from "other sources", however, shows an excess of waste material by weight over used material in layers 4 and 5. In layer 3b, on the other hand, the pattern reverses, and the weight of waste material is less than that for the used group. Thus the degree of usage of obsidian materials from other sources than Mayor Island (which was always greater than the amount discarded) was less during the formation of layers 4 and 5, but this was reversed during the layer 3b occupation where more "other sources" material by weight was used than discarded. The average size of layer 3b flakes also decreases slightly when compared with the other layers (except the layer 4 used Mayor Island obsidian) while the utilisation of pieces showing cortex material goes up in relation to the other layers. Furthermore, the distribution of obsidian from "other sources" and of cortex pieces throughout the layers suggests that obsidian from other layers was not being reused.

Basalt

The nearest known pre-European basalt quarry is Tahanga (N40/8) at the south end of Opito Beach. This is outside the twenty-five km^2 area being discussed in this report. However, indications are that the grey stone material flake material consists mainly of Tahanga basalt (P. Moore, pers. comm.).

Table 5. Basalt pieces by number, N44/69.

LAYER	Pieces		Cores	Total
	used	waste		
3b	24	190	—	214
4	32	197	2	231
5	41	376	1	418
6	—	4	—	4
	—	—	—	—
	97	767	3	867

There were 864 pieces of basalt, excluding cores, polished and hammer-dressed flakes (Table 5). Of these pieces only 97 showed signs of use wear. However, basalt flakes were used in all layers. There were seven adzes or adze roughouts found but the number of flakes would seem higher than this number of adzes and roughout manufacture would require, unless very large blocks were brought to the site, from which small adzes and roughouts were made. It seems more reasonable to assume that shaped blocks were brought to the site and the adzes finished there and that some of these were taken elsewhere. This is consistent with the size of the waste flakes, which is generally not large, the flakes being more like those from finishing stages of the manufacturing process than those from the initial stages of shaping the block.

Sixty-five flakes showing polishing were found, the majority from layer 5. There were four hammer-dressed flakes, two from layer 5 and two from layer 4. Again this is in keeping with the final stages of adze manufacture, or in the former case, the re-working of already completed adzes.

Siliceous material

The siliceous material, excluding drill points, was separated into two categories, quartz and other stone (jaspers, carnelian and fossilised wood, etc) and these in turn were separated into used and waste pieces.

There were 276 waste quartz pieces having a total weight of 1230 g (rounded figures) and 347 waste pieces in the other materials category, having a weight of 1759 g. Of the used pieces, 105 were quartz (922 g) while there were 79 pieces in the other materials category (847 g).

Layer 3b had the least number of pieces and the least weight of material, layer 4 had more and layer 5 contained considerably more by number and weight than the other two layers. In fact it had almost twice as much siliceous material as the combined totals of layers 3b and 4. This parallels the pattern observed for the drill points noted above.

In addition there were 606 chips (pieces under 1 cm in size) of siliceous material of which 520 came from layer 5. Of these in layer 5, 323 had well defined bulbs of percussion. If these chips represent drill-point manufacture, this type of working must have been time consuming but economically important, given the size and flaking qualities of the points.

Fauna and Flora

FISH

A large amount of fish bone was found in the site (Table 6). Identification was done mainly by sorting the best preserved head bones into species and counting the maximum number of one particular bone, e.g. snapper, left dentary. Leather jackets (*Novodon scaber*) were identified by their dorsal spines as were the northern spiny dogfish (*Squalus blainvillii*). One complete bag of fish bone from layer 5 was checked as a sample of the bone range and vertebrae from flounder (*Rhombosolea* sp.) were identified (no head bones were found as they are probably too fragile to survive in a midden). The small collection of layer 6 fish bone was also investigated and flounder vertebrae were present.

Table 6. Minimum number of fish in each layer and their percentage of site total.

SPECIES	Layer 3b No.	%	Layer 4 No.	%	Layer 5 No.	%	Layer 6 No.	%
Snapper *(Chrysophrys auratus)*	9	6.71	16	11.94	38	28.35	—	
Leather jacket *(Novodon scaber)*	4	2.98	6	4.47	21	15.67	—	
Butter fish *(Coridax pullus)*	2	1.49	4	2.98	6	4.47	—	
Spotty *(Pseudolabrus celidotus)*	—	—	—	—	3	2.23	—	
Northern Dogfish *(Squalus blainvillii)*	—	—	1	0.74	3	2.23	—	
Trevalli (?) *(Caranx lutescens* ?)	—	—	—	—	2	1.49	—	
Flounder *(Rhombosolea* sp.)	—	—	—	—	1	0.74	1	0.74
Horse Mackerel (?) *(Trachurus* sp. ?)	1	0.74	—	—	1	0.74	—	
Parrot fish *(Pseudolabrus* sp.)	1	0.74	5	3.73	1	0.74	—	
Barracouta *(Thyrsites atun)*	—	—	—	—	1	0.74	—	
Hapuka or Kingfish *(Jordanidia solandri* or *Polyprion oxygeneios)*	1	0.74	—	—	1	0.74	—	
Kahawai *(Arripis trutta)*	—	—	1	0.74	1 (?)	0.74	—	
Porcupine fish *(Allomycterus jaculiferus)*	—	—	—	—	1	0.74	—	
Unknown	—	—	—	—	1	0.74	—	
Unknown	—	—	—	—	1	0.74	—	
	—		—		—		—	
	18		33		82		1	

Snapper represented from between 45-50% of fish in each of the three main layers (3b, 4 and 5). Snapper is probably present in layer 6 but only tentatively identified from body bones. Leather jackets, representing from 18-25%, is the next most important fish followed by butterfish (*Coridodax pullus*) with from 7-12%. The only other fish to appear in all the layers is the parrot fish (*Pseudolabrus* sp.) with one example in layer 3b, five in layer 4 and one in layer 5 (Table 6).

A. B. Stephenson (pers. comm.) suggests that, allowing for sampling errors, impermanence of some types of fish bone and the problems of fish bone identification, the material in the site indicates line fishing rather than netting.

For some of the smaller kelp feeders such as spotties (*Pseudolabrus celidotus*) a drop net such as suggested by Law (Law 1972, p. 48) could have been used. Law (ibid., p. 98) quotes Witter (Witter 1969, p. 51) as suggesting that leather jackets, having a small mouth, probably could not take the New Zealand Polynesian fish-hooks. Witter

goes on to say that he understood that these fish are hardly ever caught on small steel hooks .However, I have personally caught leather jackets on small to medium sized hooks (No. 2-4) in the French Pass area. A keen fisherman has stated to me that leather jackets can be easily caught near the surface, by spearing, in harbours and around jetties in parts of the South Island. It is interesting to note that Law's Harataonga midden site (N30/5) has a very similar collection of fish bones with snapper as the dominant species and leather jackets next (Law 1972, p. 98, Table 4).

Since Hot Water Beach is an ocean beach the catching of flounder there is not very likely but these fish could have been speared, trapped or netted in the Purangi River or the Whitianga estuary.

One tooth from the mako shark (*Isurus mako*) was found in layer 4 and one spicule from the porcupine fish (*Allomycterus jaculiferus*) in layer 5. The porcupine fish is a shallow water fish but as it is reputed to be poisonous its presence in the layer is interesting. Spicules from the same fish were also noted by Law (ibid., p. 98) in the Harataonga midden (N30/5).

The presence of large amounts of vertebral material and rib/spine bones suggests that fish were eaten on the spot rather than being dried and taken elsewhere. Of the main cultural layers layer 3b had the lowest weight of fish bone, 275 g, layer 4 was next with 552 g and layer 5 the most with 1,386 g.

The presence of kahawai (*Arripis trutta*), kingfish (*Jordanidia solandri*) and barracouta (*Thyrsites atun*) together with a lure shank in layer 5, and kahawai bones and a lure point in layer 4 indicate that trolling was carried out but lures were not a feature of the site and nor were the fish caught in this way. Local coastal and tidal harbour fishing, trapping and netting were probably more important than deep water fishing or ocean netting. It raises the question of how important canoes were to the various occupiers of the site. Most fish could have been caught from the rocks or hand netted.

BIRDS

Fish and birds were the major source of protein in the site. Fish, weight for size, produced the highest percentage of flesh but birds had a wider economic importance.

Bird flesh has longer keeping qualities than fish. This may be only twenty-four hours but in those days this time must have had a significance in terms of food preparation and distribution. Birds' eggs were gathered and eaten (unidentified pieces of egg shell were found in layer 3b) and the importance of bird bone for artifacts, awls, needles, fish-hooks, etc, needs no elaboration.

Although no archaeological evidence remains for the use of bird feathers for cloaks and decoration, it is unlikely that some use of bird feathers was not made considering the number of birds found. There are many references to the use of feathers, for example Banks (Beaglehole 1962, p. 15) talks of dogskin cloaks and "Some there were who had these dresses ornamented with feathers and one who had an intire dress of red feathers of Parrots, but these were not common." In a footnote Beaglehole states that the parrot was a kaka. At Hot Water Beach the kaka was one of the commonest birds represented, and it is possible that the red feathers were used for decoration.

Table 7. Numbers of birds by layer and habitat.

SPECIES	Common name	Layer 3b	Layer 4	Layer 5	Layer 6
Ocean/sea/coast					
Diomedea sp.	Albatross	—	1	1	
Thalassarche sp.	Mollymawk	1?	1?	1	
Eudyptula minor subspecies	Little blue penguin	1	3	5 (1*)	
Larus dominicanus Lichtenstein	Gull, black backed	—	—	1	
Pachyptila vittata	Prion, broad billed	—	—	1	
Pelecanoides urinatrix	Petrel, northern diving	1	—	1	
—	Petrel sp.	1*	1	2 (1*)	
Puffinus griseus	Shearwater, sooty	—	—	1*	
Puffinus gavia	Shearwater, fluttering	1	—	1	
Puffinus assimilis	Shearwater, Chatham Island	—	—	1	
Phalacrocorax carbo	Shag, black	—	—	1	
Phalacrocorax melanoleucos	Shag, little or white fronted	—	—	1	
Strictocarbo punctatus	Shag, spotted	—	—	1	
		—	—	—	—
		5	6	18	Pres?
Forest					
Apteryx australis mantelli Bartlett	Kiwi	1	1	1	—
Callaesas cinerea wilsoni	Wattled crow	—	2	4 (1*)	—
Cyanoramphus n. novaezelandiae	Parakeet, red fronted	—	1	2	—
Hemiphaga novaeseelandiae	Pigeon	—	1	2	—
Heteralocha acutirostris	Huia	—	—	1 E	—
Nestor meridionalis septentrionalis	Kaka	3	5	10	—
Ninox n. novaeseelandiae	Morepork	—	1	1	—
Prosthemadera n. novaeseelandiae	Tui	1	1	6 (1*)	—
Turnagra capensis	Thrush (native)	—	—	1	—
Passeriformes	Unidentified small birds	?	?	Pres.	—
Strigops habroptilus	Kakapo (No layer but presesnt in site)	?	?	?	?
		—	—	—	—
		5	12	28	?

Lake/river/swamp					
Palaeolimnas chathamensis, Forbes	Coot (Extinct)	—	—	1 E	
Anas sp.	Duck/teal	1	—	Pres. (*)	
		—	—	—	—
		1	—	2	Pres?
Open country					
Circus eyles N.I. subspecies	Hawk (Extinct)	1 E	—	—	
Falco novaeseelandiae Gmelin	Falcon	—	1	1	
Gallirallus australis	Weka	—	1	3 (1*)	
Gallirallus minor	Little woodhen (Extinct)	—	—	1 E	
		—	—	—	——
		1	2	5	Pres?
Moa					
Dinornis sp.	Dinornis moa	Pres?	Pres?	Pres (1*)	Pres?
Euryapteryx sp.	Moa, small	Pres?	Pres?	Pres.	—
Euryapteryx exilis	Moa, small	Pres?	Pres?	Pres (1*)	—
Euryapteryx curtis?	Moa, small	?	?	Pres?	1*
Pachyornis mappini? Archey	Moa	?	?	?	?
Moa, unspecified		Pres.	Pres.	Pres.	Pres.

Key

1*	=	immature bird.
2 (1*)	=	immature bird, included with total.
1?	=	either albatross or mollyhawk but probably as indicated.
E, next to a number	=	Extinct.
Pres.	=	present but number and species not identified.
Pres?	=	identification not fully established.
?	=	disturbed material, could be from any layer.

Banks also notes (ibid., p. 13) that ". . . the most disgustingful thing about them is the Oil with which they daub their hair; this is melted from the fat of either fish or Birds . . ." suggesting that bird fat had a cosmetic use as well.

Banks' observations refer to people some hundreds of years later than the people responsible for the cultural layers 4 and 5. His remarks may not necessarily be applicable to an earlier period but it seems reasonable to assume that elements of these traditions might already have been present. There is direct evidence in the site of some use of the kaka other than food, in the worked bone described above (p. 46).

Twenty-nine named species of birds were recorded in the site (Table 7), moa being counted as one species because of the problem of identification (tentative identification of moa by species is given in Table 7). Passeriformes and other small birds are not included in the species count, although they were present in layer 5 and possibly in layers 4 and 3b.

Twenty-seven of the 29 species were represented in layer 5. The twenty-eighth, the extinct hawk (*Circus eyles*), occurs only in layer 3b, and the kakapo (*Strigops habroptilus*) came from the disturbed material. Fourteen species were represented in layer 4 and 11 in layer 3b.

Table 8 shows the numbers, habitat and percentages within each layer and Table 9 the numbers and percentages between the layer numbers and the total number of birds in the site. Although the presence of moa is noted in the two tables, moa is not included in the total and percentages of birds in the site. Forest birds form the

Table 8. Bird numbers, habitat and percentages for each layer.

	Layer 3b		Layer 4		Layer 5		Layer 6
	No.	%	No.	%	No.	%	
Sea birds	3	30.00	6	30.00	18	33.96	—
Lakes/rivers/streams	1	10.00	—		2	3.77	—
Open country	1	10.00	2	10.00	5	9.43	—
(Moa)	Pres.		Pres.		Pres.		Pres.*
Forest	5	50.00	12	60.00	28	52.83	Pres.?
	10		20		53		Pres.

* The presence of moa in every layer is not counted as a number in the above lists.

Table 9. Bird numbers, habitat and percentages for whole site.

	Layer 3b		Layer 4		Layer 5		Layer 6
	No.	%	No.	%	No.	%	
Sea birds	3	3.61	6	7.22	18	21.69	—
Lakes/rivers/streams	1	1.20	—	—	2	2.40	—
Open country	1	1.20	2	2.40	5	6.03	—
(Moa)	Pres.*		Pres.*		Pres.*		Pres.*
Forest	5	6.03	12	14.45	28	33.73	Pres.?
	10		20		53		Pres.

* The presence of moa in every layer is not counted as a number in the above lists.

largest group followed by sea birds. Two shag species (*Phalacrocorax carbo* and *P. melanoleucos*) have been included in the ocean/sea coast list. They could equally well have been placed in the lake/river habitat, as they may be found both coastally or inland. The inclusion in either category does not change the order mentioned above, although it changes the percentage slightly, so the numbers given in the tables under certain headings are a guide only.

The method used in establishing the minimum numbers of bird species present was as described by Law (1972, p. 96).

Immature birds

Of the eight immature birds present in the site, excluding moa, all except one were found in layer 5 (Table 7). Most of the birds nest in late spring or early summer (September, October, November).

The sooty shearwater or mutton bird (*Puffinus griseus*) nests later than most, hatching mostly in late January with the young leaving in late April or early May (Falla et al. 1970, p. 42). The weka can have more than one clutch in a season with eggs laid from September to April (ibid., p. 106).

Although there are a number of immature birds in layer 5, more remains are mature, so that although this cultural layer was certainly occupied in the spring and summer there is nothing to suggest that it did not continue into a winter season, if not longer. There are not enough immature remains to suggest concentrated gathering of certain species and their preservation. Many of the bones identified were body bones (e.g. corocoid, vertebra, femur). The evidence leans towards birds being eaten on the spot rather than preserved.

Distribution by layers

Layer 3b contained the fewest bird species (eleven species) excluding the moa and there are equal numbers of land and sea birds. In the other two cultural layers there is greater emphasis on forest birds and then on sea birds. It is interesting to note that bird bone weights in layer 3b drop very little below that of layer 4 (Tables 10, 11), although the number of species drops in layer 3b. The kaka is the dominant bird, as it is in all layers. One extinct bird, the hawk (*Circus eyles,* N.I. subspecies) is present which is not found in any other layer.

Table 10. Bird bone weights and percentages for each layer.

	Layer 3b		Layer 4		Layer 5		Layer 6		Total
	g	%	g	%	g	%	g	%	g
Bird bone	161	89.94	170	43.92	671	45.33	2	20	1004
Moa	18	10.05	217	56.07	809	54.66	8	80	2056

Table 11. Bird bone weights and percentages for whole site.

	Layer 3b		Layer 4		Layer 5		Layer 6		Total
	g	%	g	%	g	%	g	%	g
Bird bone	161	7.83	170	8.26	671	32.63	2	0.09	1004
Moa	18	0.87	217	10.55	809	39.34	8	0.38	2056

In layer 4 more bird species (14 species) are present, and forest birds are dominant. The pattern is similar to that of layer 5, the greatest numbers of birds come from the forest, next come sea birds, then open country and finally river and swamp birds. Kaka are the commonest birds followed by the little blue penguin. The rest are represented by only one or two individuals.

Moa bone is still present in layer 4, mainly as industrial bone, but a toe bone from *Euryapteryx* (probably *E. exilis*) found in square M 10 and a vertebra fragment from square M 12 suggest that the moa may still have survived in the area at the time of the layer 4 occupation. R. Scarlett (pers. comm.) refers to one piece as being obviously fossil bone. This might indicate that avenues other than fresh bone were being exploited because of scarcity of these birds.

Layer 5 contained the greatest number of species (27 species), the greatest number of birds and the greatest weight of bone. Forest birds were best represented and sea birds next. There is a minimum of ten kaka and five little blue penguin and a number of tui and wattled crow are present (Table 7).

The little blue penguin breeds all along the Coromandel coast. Young, inexperienced birds are often cast up exhausted or dead along the shore after storms or prolonged rough weather. This might account for some of the number.

Shags are common along the coasts and estuaries and the petrels and shearwaters could have been taken during the nesting period. Also petrels are apparently flightless during a short period of moult (Falla et al. 1970, p. 57).

Considering the land forms around the site and the presence of rivers and swamps in the environs there are surprisingly few swamp birds, especially duck, when, during late summer, they may be more easily caught during their moult. Other bird evidence suggests that the site was probably occupied at that season.

Of the now extinct birds (apart from the moa, which, if a viable species at that time, would probably have been found along the estuarine river flats and in the lower hinterland of the Whitianga area) one bone from the extinct coot (*Palaeolimnas chathamensis,* Forbes) was found in layer 5 and the little extinct woodhen *(Galliralus minor*) and the huia (*Heteralocha acutirostris*) were also hunted.

Both adult and immature weka were caught and the tui (*Prosthemadera n. novaseelandiae*) and wattled crow (*Callaesas cinerea wilsoni*) were well represented. A number of small unidentified birds, mainly passeriformes, indicated that a wide range of bird trapping, snaring and hunting occurred.

Moa was represented in layer 5 by *Euryapteryx exilis* in slightly sub-adult form together with bone from an immature bird of *Dinornis* species. *Dinornis* and *Euryapteryx* in adult form were also present but not identifiable as to species (Table 7). Most bird bone in layer 6 was moa. One piece of moa right tibio-tarsus from a small immature bird, probably *Euryapteryx curtis,* was identified and possibly some fragments were of *Dinornis* sp. Other bird bone was fairly fragmentary.

SHELLFISH

Shells were scattered throughout the layers rather than in concentrated heaps, except for the mud snail (*Amphibola crenata*). Several collections of 30-40 of these shells were found, mainly in layer 5 although they were scattered throughout the layers as well. A total of 5114 whole shells were counted, representing 16 species (Table 12) (bivalves were sorted into right and left valves and the maximum number of one side taken to represent the whole animal). Other species were present in ones or twos but were not included in the tables because they were not economically important. Broken shells have been excluded except for mussel (*Perna* spp.) and paua (*Haliotis* sp.). As these were always in a fragile condition they were sorted by hinges or rims. Only two valves of the oyster (*Ostrea* sp.) were found, one of these in the disturbed area and one in layer 5 in a very decayed condition. They were included in the "not economically important" numbers. Kino or sea urchin (*Evechinus chloroticus*) and scallop (*Pecten novaezelandiae*) were present. Kina was always in broken bits as might be expected from present day methods of eating the shellfish. Paua (*Haliotis* sp.) was found only in layer 5. The most common species throughout the site, except for layer 4, was the cats-eye (*Lunella smaragda*). The opercula of the cats-eye were used for the count as they were best preserved, many of the cats-eye shells being damaged and therefore not counted. Cats-eye counts represent 7.41% in layer 3b. The number drops to 5.12% in layer 4 and rises to 30.91% of the total shells in the site in layer 5 (Table 12).

Table 12. Numbers of shellfish and percentages of site total.

SPECIES	Layer 3b No.	%	Layer 4 No.	%	Layer 5 No.	%	Layer 6 No.	%
Rocky shore								
Lunella smaragda	379	7.41	262	5.12	1581	30.91	3	0.05
Haustrum haustorium	28	0.54	18	0.35	40	0.78	—	—
Neothais scalaris	7	0.13	1	0.01	4	0.07	—	—
Cellana radians	80	1.56	22	0.43	363	7.09	3	0.05
Cellana denticulata	6	0.11	8	0.15	45	0.87	—	—
Cookia sulcata	3	0.05	4	0.07	10	0.19	—	—
Haliotis sp.	—	—	—	—	8	0.15	—	—
Nerita melanotragus	124	2.42	90	1.75	206	4.02	7	0.13
Zediloma sp.	41	0.80	33	0.64	83	1.62	2	0.03
Perna spp.	1	0.01	7	0.13	37	0.72	—	—
Evichinus chloroticus	Pres.	—	Pres.	—	Pres.	—	—	—
	669		445		2377		15	
Sandy shore/mud flat								
Amphidesma australe	45	0.87	199	3.89	153	2.99	1	0.01
Amphidesma subtriangulatum	84	1.64	5	0.09	11	0.21	—	—
Chione stutchburyi	5	0.09	6	0.11	7	0.13	—	—
Amphibola crenata	59	1.15	459	8.97	572	11.18	2	0.03
Pecten novaezelandiae	Pres.	—	Pres.	—	Pres.	—	—	—
	193		669		743		3	

Of the sandy shore/mud flat species the mud snail in layer 3b represents 1.15% of the site total, 8.97% in layer 4 and 11.18% in layer 5. Although there is a low percentage in layer 3b the total number of shellfish also drops in that layer so that

comparison within the layer makes it more significant. As mentioned previously, the focus of layer 3b was probably not within the area excavated but if the material excavated does provide a representative sample of the activities, changes are suggested. It could also be argued that shellfish gathering was not so important in layer 3b because other food sources, e.g. agriculture, had become more important.

Pipi and tuatua (*Amphidesma* sp.) and cockle (*Chione stutchburyi*) form a very small percentage throughout the site, although the number of tuatua increases to eighty-four in layer 3b from the five represented in layer 4 and eleven in layer 5. The increase of tuatua in layer 3b may be significant. These shellfish are open beach rather than estuarine and although they are included amongst the sandy shore/mud flat category their habitat places them in an intermediate position between estuarine and rocky shore and nearer rocky shore for gathering purposes.

Big limpets (*Cellana* sp.) are present in all layers but they are fewer and tend to be smaller in layer 3b. Layer 4 is rather similar to layer 3b but in layer 5 the pattern changes. *Cellana radians* is very important (see Table 12), *Cellana denticulata* is less important but the majority of shells are very big, one measuring 7 cm across.

Tables 13 and 14 show the relative percentages of rocky shore/sandy shore and mud flat shellfish according to their habitats. It is interesting to note that layers 3b, 5 and 6 show a preponderance of rocky shore shellfish but in layer 4 the emphasis is on sandy shore/mud flat species. Although the cats-eye is important in layer 4, the two dominant shellfish are the mud snail and the pipi.

Table 13. Numbers and percentages of shells according to habitat for each layer.

	Layer 3b		Layer 4		Layer 5		Layer 6	
	No.	%	No.	%	No.	%	No.	%
Rocky shore	669	77.61	445	39.94	2377	76.18	15	83.33
Sandy shore/mud flats	193	22.38	669	60.05	743	23.81	3	16.66
	862		1114		3120		18	

Table 14. Numbers and percentages of shells according to habitat for whole site.

	Layer 3b		Layer 4		Layer 5		Layer 6	
	No.	%	No.	%	No.	%	No.	%
Rocky shore	669	13.08	445	8.70	2377	46.48	15	0.29
Sandy shore/mud flats	193	3.77	669	13.08	743	14.52	3	0.05

On the basis of the sixteen species represented in any quantity, layer 3b occupation people were exploiting the shellfish environment in a ratio (rocky shore/sandy shore, mud flat) of 3 : 1. Layer 4 produced a ratio of 2 : 3 and layer 5, 3 : 1.

Changes in sea shore shellfish gathering, especially in layer 4, could be due to over-exploitation of the rocks during the layer 5 occupation, forcing the exploitation of a different environment by the layer 4 occupation people and the return to sea shore species later during the 3b occupation.

The dominant species of shellfish in layers 3b and 5 is the cats-eye (*Lunella smaragda*). In layer 4, however, it is the mud snail (*Amphibola crenata*) that forms the majority of shells, although the second most important shell is the cats-eye. Generally speaking the cats-eye represents a steady and reliable food source throughout the occupation of the site. As with the limpets, however, the largest shells of the cats-eye were found in layer 5.

Of the total shells (5114), 68.55% (3506) represent rocky shore shellfish and the remaining 31.44% (1608) are sandy shore/mud flat species.

MAMMALS

Dog

These were present in all layers, although in layers 3b and 6 only immature bone was present.

The bone found in layer 3b came from a newly born or unborn pup. It showed signs of having been gnawed (agent unknown) but if chewed by a dog would probably have been more damaged than it was.

Layer 4 contained at least one adult and one immature dog.

Layer 5 had a minimum of four adults and a number of immature bones including at least one puppy.

J. Allo (pers. comm.) states that there was a minimum of six atlas vertebrae and six dog skulls but does not specify from which layer they came. She suggests that one of the skulls was broken at the frontals, probably for the extraction of the brain for consumption.

It would be interesting to know what the dogs fed on, as, apart from the gnawed pup bone in layer 3b, there is nothing to suggest that, in general, discarded bone was available for dogs. Fish bone seems to be a possibility but free roving dogs should have left some gnawing evidence on other bone material.

Concentrations of coprolites were found in layer 5, especially in squares M 11 and M 12. This could indicate the tethering of dogs but Allo (pers. comm.) suggests that it is common for semi-wild dogs to defecate in certain areas from choice, so coprolite collections do not necessarily mean tethering.

Seal

Seal bones were identified in all layers. The majority are probably from the southern fur seal (*Arctocephalus fosterii*) but the bones have not been fully identified.

The three main cultural layers all produced at least one adult and one immature animal. Layer 6 contained part of an atlas vertebra of a seal.

The fur seal whelps between about January and March and the pups could be caught any time between then and the following summer, but, depending on their maturity, pups could represent an autumn seasonal activity for layers 3b, 4 and 5.

Whale

An ear bone and some bone fragments of a small whale were found in layer 5. Some fragments were also found in the disturbed material.

Rat (Rattus exulans)

Rat bones were found in the three main cultural layers. Layer 3b provided evidence of at least one individual and layer 4, two. Only limb bones were present in these two layers. Layer 5 contained a minimum of ten rats (ten right femurs). There were also seven left mandibles and numerous cranial and body bones.

There is evidence of possible rat gnawing on a few bones from layer 5 but none in layer 4 and only the one gnawed (agent unknown) dog bone in layer 3b. Rats may have been scavenging during the deposition of layer 5 and died in the area, as well as being used for food, but the absence of head bones in the other two layers makes natural death unlikely.

Man

No human bone was found in the site.

LAND SNAIL SHELLS

Two types of land snail shells were found in the site, a small *Phenacohelix* species and the larger carnivore, *Rhytidia greenwoodi*. Most of the shells were in a very fragile condition and the total count (73) includes only the complete shells. Damaged ones were discarded. Both species are forest dwellers (A. W. B. Powell, pers. comm.), being present in light coastal forest and scrub. They require vegetation dense enough to be permanently damp throughout the summer.

Both species were found in large numbers in layer 5 (66) but the numbers drop off considerably in layers 4 (3) and 3b (2).

Layer 6 (as already mentioned) was an insignificant part of the excavation, although it could well have represented the outer edge of an extensive occupation. Snails (2) were present and considering the numbers in layer 5 which sealed it, forest must have been associated with layer 6 as well as layer 5.

The numbers of snails in layer 5 indicates that the site, at that time, was amongst, or very close to, heavy scrub or forest. The smaller numbers in the later layers is possible evidence that bush had retreated from the site, because of burning or felling, or both. The absence of charcoal even as ash in the excavated portion of layer 5 and the presence of numerous land snails indicates that the activities carried on at that time were on the edge of, if not amongst, the trees.

REPTILES

The right and left femur of the tuatara (*Sphenodon punctatus*) were found in layer 5, probably from the same animal.

INSECTS

Square M 11, layer 5, produced fragments of a sand scarab (*Pericoptus* sp.) which is probably sub-fossil. Because of the depth it was found and its appearance it could possibly be from the layer 5 occupation time (K. A. J. Wise, pers. comm.). It is usually found along sandy coasts, often under driftwood or logs above high water.

Miscellaneous

SEEDS

Two small rounded yellow/brown seeds were found, one in square M 11, layer 5, and the other in square L 11, layer 3b. They were both seeds from a convolvulus (*Calystegia* sp.), which is a dune plant, although it grows in other areas. Similar seeds were found in archaeological material from Lake Mangakaware (J. Goulding, pers. comm.).

IRON

A small piece of very rusty iron was found in square M 11, layer 4. It is presumed to be a rusty nail and to have fallen into the square from the surface during excavation. There were also two fragments of iron of a similar nature from layer 3b, square L 11.

Discussion

PUMICE

Although there was a lot of pumice scattered throughout the site it was the presence of a grey water-worn pumice in heavy concentrations in layer 5, later identified as Loisels pumice (H. W. Wellman, pers. comm.), that was particularly interesting. This Loisels pumice has been assigned a more recent carbon 14 age than the approximate A.D. 700 originally suggested by Wellman (1962, p. 29).

Wellman now states that the pumice shower seems considerably later and probably about A.D. 1300 (Wellman, pers. comm. 1970). Assuming that the pumice shower is now dated fairly accurately, its presence in the site makes it a time marker for the deposition of layer 5, which must have commenced fairly soon after the explosion shower, as in places, square M 11 for example, the pumice rests either on sterile sand or immediately above layer 6 in concentrated layers. Layer 5 overlies this without any indication of a time lapse, although the fact that the pumice is water rolled and sea deposited must imply some time between the explosion and the deposition of the pumice on the beach.

Although there is no carbon 14 date for layer 5, the Loisels pumice evidence places layer 5 as some time not too long after A.D. 1300.

Layer 3b had a sparse amount of Loisels pumice well scattered throughout the layer. Other sea-washed pumice was also present, but not in any quantity.

Layer 4 contained Loisels pumice in considerable quantities but nowhere did it occur in well defined pockets, and, as with layer 3b, it was scattered throughout the layer in a random fashion. There were also numerous pieces of rusty orange and blackish pumice, generally larger than the Loisels type, which probably came from the central North Island zone (B. P. Kohn, pers. comm.).

Apart from the large deposits of Loisels pumice in layer 5, other pumice was also present, especially large and small pieces of the Taupo type; a piece of blackish pumice foreign to the central North Island volcanic zone (it may have originated from the Auckland volcanic centre or from the Kermadec-Tonga group) and a dark brittle glassy pumice of unknown origin (B. P. Kohn, pers. comm.).

Only two pieces of Loisels pumice were found in layer 6 and these were probably accidental intrusions from layer 5. Its presence was not noted in square L 10 where the layer was better defined. No other pumice was found in the layer. Although layer 6 was erratic in its distribution, the apparent lack of Loisels pumice suggests that the layer was deposited before A.D. 1300.

ARTIFACTUAL AND MIDDEN MATERIAL COMPARISONS

Two other sites have similar deposits of Loisels pumice, N40/3, the Opito Beach site, and N30/5, the Western midden at Harataonga Bay, Great Barrier Island.

In the Opito N40/3 site the significance of Loisels pumice was not realised in the 1957/58 excavation, although its presence was noted. The following year further work was done to establish its position in the cultural layers. "Pumice was found at all levels but material that could be described as 'black', or even 'gray' as opposed to 'white' did not appear below a certain level in the sequence, stratigraphically the upper half of the sand layers dividing the two cultural horizons at the base of the deposits" (Golson 1959a, p. 18). This sand layer dividing the two main cultural layers has been further defined as layer 4b by Green in his summary (Green 1963, pp. 59-60).

Layer 4b must have contained some cultural material as Green (1963, p. 60) suggests that obsidian dates make 4b younger than 4c. Layer 4c, which contains no Loisels pumice, has a radiocarbon age reported as A.D. 1310 $\pm$ 50. The upper part of layer 4b at Opito and layer 5 at Hot Water Beach would thus be contemporary and have been deposited some time soon after A.D. 1310 $\pm$ 50. (This date is uncorrected for the new half life or secular effect.)

It is unfortunate that there is no list of artifacts from layer 4b specifically mentioned in the literature. Material from layers 4c, 4b and 4a is discussed by Golson (1959b, pp. 44-45). The general list included moa skeletal bones, industrial moa bone, moa egg-shell, adzes of Duff types 1A, 2A, 3A and 4A, one-piece fish-hooks, an unperforated lure hook point, shell copies of shark tooth necklace units, bird bone tube, *Dentalium nanum* and shell necklace units. It is interesting to note the variety of threaded ornaments present in both the Opito and Hot Water Beach sites. No "reel" units were found in N40/3.

Loisels pumice was also found in the lower part of the midden N30/5 at Harataonga Bay, Great Barrier Island (Law, 1972). Various problems make association of specific artifacts with the pumice layer difficult but Law suggests that it is possible to consider the midden as representing a single occupation.

Amongst the artifacts found in N30/5 were several portions of Opito, Type 1, moa bone fish-hooks, a lure shank of Crosby's early grooved series (surface find), a single perforated shell lure point, a fine but broken bone needle, a tattooing chisel, part of a bird bone spear, several roughouts, drill points, files and four *Glycymeris laticostata* shells that may have been used as necklace units.

Shellfish in N30/5 was mainly rocky shore type with a few mud flat/tidal estuary species. *Amphibola crenata* (mud snail) was absent. Seal and dog remains were present as well as one species of moa, probably *Euryapteryx geranoides.* (The presence of moa on the island has not yet been fully established so that the moa material may have been imported from the mainland.)

The other birds in the site were, on the whole, similar to those at Hot Water Beach, and show that *Eudyptula minor* (sub-species), the little blue penguin, and *Nestor meridionalis septentrionalis,* the North Island kaka, were better represented than other species in both sites. However, *Macroptera gouldi* Grey, the grey-faced petrel (the traditional North Island mutton bird) was exploited at Harataonga Bay but not represented at all at Hot Water Beach. Comparisons between the fish species of layer 5 at Hot Water Beach and those of the Harataonga midden N30/5 have already been made (see above, p. 59).

The similarities between the three known sites containing Loisels pumice suggests that a generalised adaptation to the exploitation of the environment of the Coromandel - Great Barrier Island - East Coast was already well established by about A.D. 1300 and that there was little differentiation between the cultural adaptations in the three sites.

RADIOCARBON DATES

The first series of radiocarbon dates from layer 4 (N.Z. 1169-1171) has been published (Leahy 1971, p. 63). N.Z. 1169 and N.Z. 1170 were charcoal, while N.Z. 1171 was grease extracted from the same sample as N.Z. 1170. Because of the discrepancy between the two dates from the same sample, the Institute of Nuclear Sciences tested further samples from the same layer (N.Z. 1296, *Amphibola crenata* shells, N.Z. 1297, *Amphidesma australe* shells, and N.Z. 1298 and 1299, fish bone carbonate and organic fraction from fish bone respectively).

Sample N.Z. 1298, the fishbone carbonate, produced a modern date. The very recent result provided by N.Z. 1171 and the modern result of N.Z. 1298 have not been included in the dates below because their assessments do not conform to the other evidence. However, all results are set out in Table 15.

If all the remaining results are considered, at one standard deviation, a date in the range between A.D. 1350 and 1540 is quite acceptable for layer 4, with an age earlier than A.D. 1390 considerably less likely.

Table 15. Carbon dates from site N44/69.

Lab. No.	$\delta^{13}C$ w.r.t. PBD	$\triangle^{14}C$ w.r.t. 0.95 Oxalic Acid	^{14}C age w.r.t. Oxalic Acid (5568 half-life, uncorrected for secular effects)	CALENDRICAL AGE IN YEARS B.P. Following laboratory advice the best result, calculated by using new half-life, appropriate standards, and corrected for secular effects
N.Z.1169	— 24.8°/oo	— 54.2 ± 4.9°/oo	421 ± 40	457 ± 50
N.Z.1170	— 24.9°/oo	— 61.0 ± 9°/oo	484 ± 79	501 ± 89
N.Z.1171	— 27.7°/oo	— 25.0 ± 9°/oo	177 ± 77	245 ± 77
N.Z.1296	+ 1.2°/oo	— 94.1 ± 4.8°/oo	453 ± 40[1]	470 ± 50
N.Z.1297	+ 1.2°/oo	— 102.0 ± 4.8°/oo	524 ± 40[2]	557 ± 50
N.Z.1298	— 4.3°/oo	+ 10.0 ± 12°/oo	modern[3]	modern
N.Z.1299	— 13.9°/oo	— 79.0 ± 9°/oo	325 ± 78[4]	417 ± 88

[1] $\triangle^{14}C$ w.r.t. N.Z. Marine shell standard: — 57.3 ± 4.8°/oo
[2] $\triangle^{14}C$ w.r.t. N.Z. Marine shell standard: — 65.6 ± 4.8°/oo
[3] $\triangle^{14}C$ w.r.t. N.Z. Marine standard: + 51.0 ± 12°/oo
[4] $\triangle^{14}C$ w.r.t. N.Z. Marine standard: — 42.0 ± 9°/oo

Thus an age in the 15th century is to be preferred for layer 4.

This is consistent with the recovery of Loisels pumice throughout layer 5 and the reassessment of the date of the eruption at approximately A.D. 1300. Layer 5 was almost certainly formed after A.D. 1300 as the pumice itself is weathered and water-worn in the layer. This gives a *terminus post quem* for the main occupation layers of the site so that layers 5 and 4 were formed between approximately A.D. 1300 and A.D. 1540 with a reasonable assumption that layer 5 accumulated in the 14th century.

Conclusions

Excavations at Hot Water Beach showed that there were three main occupation layers, layers 5, 4 and 3b. Layer 6, although separated by time from layer 5 and of an indefinite nature, was similar to layer 5 in content.

Evidence from layer 5 occupation indicates that the site was situated on the dune flats above the stream mouth and ocean beach. The presence of numerous land snails in the layer suggests that the coastal bush must have been close to the stream and beach edge and that the site was partly within this bush.

Layer 5 adzes and roughouts appear to be Archaic in style but not clearly defined as to type, except for the side hafted adze. Stone working was important. The basalt flake material suggests adze finishing rather than initial block shaping as the flakes were generally not large. The main quarry for basalt was to the north, at Tahanga, on the south end of Opito beach. This basalt source was used throughout all the layers. The large number of basalt flakes suggests that adzes were finished at the site but used elsewhere, and the presence of a number of flakes showing polishing indicates that adzes were reworked as well as manufactured.

Numerous drill points were found in layer 5 and the presence of drilled bone and fish-hook manufacturing remains clearly show one of the uses. These drill points were probably used for wood working as well although there is no direct evidence for this. The larger basalt "hand-held" points would be too large for bone work and were more likely to have been for timber working, possibly for wooden structures, or canoe building as suggested by the presence of the side hafted adze.

Two or more sources of obsidian were used during the layer 5 occupation. Statistically the presence of more obsidian than might be expected is significant and a preference was shown for using flakes from the Mayor Island source over those from "other sources".

Fishing was mainly confined to inshore line fishing rather than extensive netting. Some trolling occurred. Canoes, if present, were probably for general purposes, transporting of people and goods, bird hunting on off-shore islands, and other seasonal occupations, as well as fishing.

Rocky shore shellfish are dominant, especially cats-eyes (*Lunella smaragda*), and as these shells did not appear burnt or deliberately broken, they may have been boiled in the hot spring or steamed in a hangi to facilitate the removal of the flesh from the shell.

Moa was probably hunted and the bones used to manufacture ornaments and tools. Moa bone was also used for fish-hooks but there is little evidence for the preparation of tabs on the site. It is possible that these may have been prepared elsewhere and brought to the site.

Bush birds were the most important species in layer 5, followed by sea birds. The kaka especially seemed to be of economic importance not only for food but for other purposes such as bone artifacts and possibly for feathers.

A number of ornaments, especially threaded items, were present either completed or in the process of manufacture. The possible tattooing chisel suggests that tattooing was practised and hair combs may have been used.

Material from layer 5 shows that there was a wide and efficient exploitation of the environment. Local stone was used extensively, and trading and exchange patterns or political affiliations were evident by the presence of obsidian from various sources, and the Tahanga basalt material.

Comparison with two other excavated sites containing Loisels pumice shows a number of similarities and indicates a fairly generalised adaptation to and exploitation of the environment by three different groups of people at that time. The presence of Loisels pumice in layer 5 suggests that the layer was probably deposited during the 13th century.

Layer 4 was similar in many ways to layer 5 but on a lesser scale. The layer generally consisted of a compact greasy black sand containing many ovens and fire pits. Associated with these were structures, possible cooking shelters or wind breaks. There were few land snails in the layer, suggesting that the bush was not near the occupied area.

Adzes and roughouts were similar to layer 5. At least two sources of obsidian continued to be used. The number of pieces and their weight conformed to statistical expectations. No ornaments were found in the layer.

Kaka was still the most important bird and the fishing and trolling followed similar patterns to layer 5. Possibly a few moa were hunted but the presence of fossil bone could indicate that moa bone had become scarce. Shellfish tended to be of the mudflat or tidal estuary types although cats-eyes remained important. This switch in shellfish gathering may have been caused by over-exploitation of the coast, political changes opening up areas not previously available, or possibly a change in food preference.

No immature animals except the seal occur in this layer.

A series of carbon dates was obtained for material from layer 4. These suggest a probable 15th century date for the cultural deposit. Overall no obvious changes in subsistence patterns between layer 5 and layer 4 occur.

Layer 3b, as it appears in the site, suggests a more restricted exploitation of the environment. Probably no bush cover existed near the area. Hangi were present but

they were few and isolated. The numbers of birds present drop and shellfish exploitation shows change. There is little evidence for the presence of moa. One-piece Opito Type 1 fish-hooks disappear and the first shell hook occurs. No ornaments were found.

Drill points and stone flakes are reduced in number. The one adze roughout retains its Archaic character. Statistical evidence indicates a probable change in the pattern of obtaining and using obsidian although the use of both Mayor Island and "other sources" continues.

No indications of structures were found in layer 3b except for one pit which could suggest some type of storage though no other evidence for agriculture is present.

A recent survey of some of the ridges behind the beach did not produce any signs of storage pits and the pa on the promontory above the site (N44/14), although showing well defined terraces and a double ditch and bank, did not have any obvious pits on the terraces.

The excavated site (N44/69) at Hot Water Beach represents a rather stabilised late manifestation of the Archaic period of New Zealand pre-history, particularly during the layer 5 and 4 occupation. Although layer 3b is similar in many respects certain changes are beginning to occur.

Acknowledgements. I would like to thank for their co-operation and assistance: The Coromandel County Council for permission to dig the site; Mrs A. McCartney for notifying the Auckland Museum staff of the site, her hospitality and assistance during the excavations and the use of her artifactual collection from the site; Mr and Mrs Pye for their interest during the excavation and help in later visits to the area; and all the people who attended the excavation, B. Pike, L. North, P. Swadling, C. Hurley, W. Walsh, D. McIntosh, G. Law and M. Law.

I would also like to express my gratitude to the following people for the work done in identifying material from the excavation: Dr A. W. B. Powell and W. Cernohorsky (shells), A. B. Stephenson (fish bone), K. A. J. Wise (insect material), J. Goulding (botanical material), Auckland Institute and Museum; R. Scarlett (bird bone), Canterbury Museum; Dr H. W. Wellman and B. P. Kohn (pumice identification) Victoria University of Wellington; R. N. Brothers, E. J. Searle and P. Moore (geological identification) University of Auckland, and J. Bertrand and C. Phillips for the illustrations.

Finally, I would like to thank Mr Turbott, Director of the Auckland Institute and Museum, for allowing me the use of the facilities of the Museum, and J. Davidson and Dr R. C. Green for their help and guidance in the preparation of this report.

REFERENCES

BEAGLEHOLE, J. C. (Editor)

1962 *The Endeavour Journal of Joseph Banks, 1768-1771.* Vol. 2. Angus and Robertson, Sydney. 406 pp.

CROSBY, E. B.

1966 Maori fishing gear; a study of the development of Maori fishing gear, particularly in the North Island. Unpublished M.A. Thesis, University of Auckland.

DUFF, R.

1956 *The Moa-hunter Period of Maori Culture.* 2nd Ed. Government Printer, Wellington. 400 pp.

FALLA, R. A., R. B. SIBSON and E. G. TURBOTT
1970 *A Field Guide to the Birds of N.Z.* 2nd Ed. Collins, London. 256 pp.

GREEN, R. C.
1963 Summaries of sites at Opito, Sarah's Gully and Great Mercury Island. *N.Z. Archaeol. Ass. Newsl.* 6 (1): 57-69.

GOLSON, J.
1959a Excavations on the Coromandel Peninsula. *N.Z. Archaeol. Ass. Newsl.* 2 (2): 13-18.

1959b Culture change in prehistoric New Zealand. In *Anthropology in the South Seas.* J. D. Freeman and W. R. Geddes (Eds.). Avery, New Plymouth. pp. 29-74.

LAW, R. G.
1970 A file manufacturing technique. *N.Z. Archaeol. Ass. Newsl.* 13 (2): 84-85.

1972 Archaeology at Harataonga Bay, Great Barrier Island. *Rec. Auckland Inst. Mus.* 9: 81-123.

LEAHY, A.
1971 Preliminary report and carbon 14 datings on site N44/69, Hot Water Beach, Coromandel. *N.Z. Archaeol. Ass. Newsl.* 14 (2): 62-63.

MORTON, J. and M. MILLER
1968 *The New Zealand Sea Shore.* Collins, London, Auckland. 638 pp.

NICHOLLS, M.
1964 Excavations on Ponui Island. *Rec. Auckland Inst. Mus.* 6 (1): 23-38.

SHAWCROSS, W.
1964 An archaeological assemblage of Maori combs. *J. Polynes. Soc.* 73 (4): 382-398.

SNEDECOR, G. W. and W. G. COCHRAN
1967 *Statistical methods.* 6th Ed. Iowa State University Press, Ames, Ia. 593 pp.

TROTTER, M. M.
1972 A moa-hunter site near the mouth of the Rakaia River, South Island. *Rec. Canterbury Mus.* 9 (2): 129-150.

WARD, G. K.
1973 Obsidian source localities in the North Island of New Zealand. *N.Z. Archaeol. Ass. Newsl.* 16 (3): 85-104.

WELLMAN, H. W.
1962 Holocene of the North Island of New Zealand: a coastal reconnaissance. *Trans. R. Soc. N.Z. Geol.* 1 (5): 29-99.

WITTER, D.
1969 Notes on the significance of the leather-jacket in middens. *N.Z. Archaeol. Ass. Newsl.* 12 (1): 51.

A FUNCTIONAL ANALYSIS OF OBSIDIAN FLAKES FROM THREE ARCHAEOLOGICAL SITES ON GREAT BARRIER ISLAND AND ONE AT TOKOROA

M. J. MORWOOD
UNIVERSITY OF AUCKLAND

Abstract. Experimentally-determined functional ranges are used to analyse the obsidian flakes from four prehistoric sites. These are an inland Archaic site from Tokoroa, and three sites of differing ages from Harataonga Bay, Great Barrier Island. The results of the flake tool analysis for each site are related to other archaeological evidence of past activities, and environmental resources. The functional ranges for the flake tools were also used as the basis of a typology for inter-site comparisons in which site and inter-site implications are discussed.

In New Zealand formal typologies of flake tools have not been successful because of the morphologically undifferentiated nature of most flaked tool assemblages (Shawcross 1964). Concentration on the functional attributes of such assemblages overcomes this difficulty, and has been undertaken both as an alternative to technological studies, and because studies of stylistic or technological features assume functional control.

For this analysis, experiments were conducted to establish parameters of functional significance, and then functional ranges for different tasks were defined in terms of these parameters. The results were then applied to four assemblages from the Auckland area. The functional distribution of obsidian at each site was then related to environmental resources and other archaeological evidence of site activities.

In the experiments flakes and cores of Mayor Island obsidian were used. The most obvious effect of obsidian use was edge damage, which was of two types: unifacial and bifacial. Unifacial edge damage resulted from scraping where only the ventral face of the tool was in contact with the material and short, small-use flakes were removed from the leading face. Bifacial edge damage resulted when both faces adjacent to the working edge were in contact with the material being worked and flakes were detached from both.

This may be associated with cutting, but not always. If an acute angled edge is used for scraping, the resulting depth of penetration into the material can lead to bifacial damage, as can turning the tool over during scraping use. Also included in this category of bifacial alteration is the snapping of small "bites" from the edges of thin blades.

Two types of use-wear were distinguished: dulling of the natural glossy lustre of obsidian by friction can occur during use, while small scratches or grooves known as striations can form on surfaces (e.g. Semenov 1964).

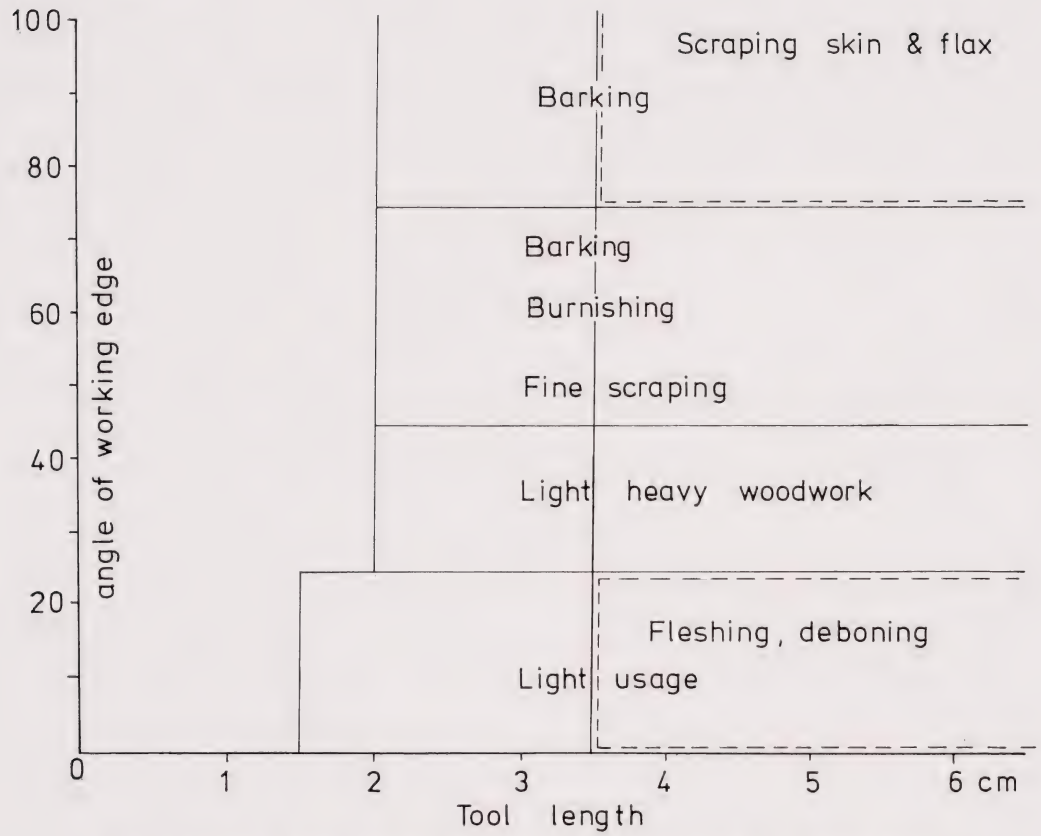


Fig. 1. Graph of experimentally-determined functional ranges for obsidian tools.

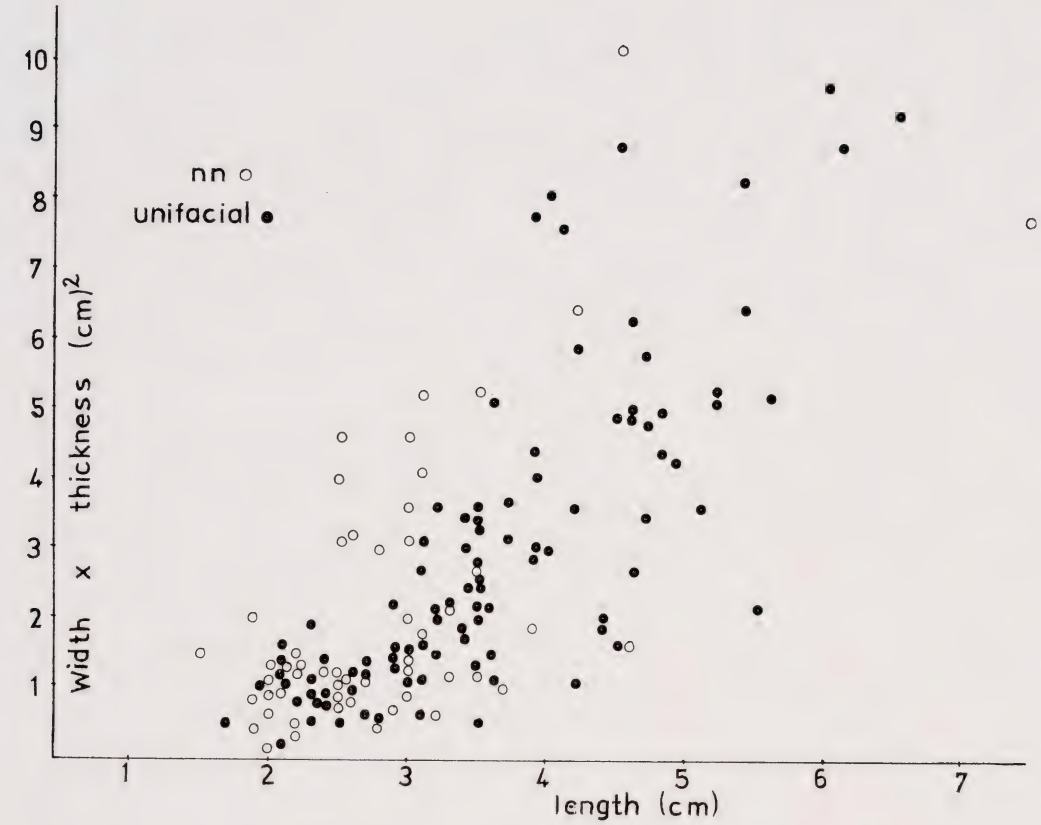
The factors determining the suitability of a particular tool for a specific task were found to include the shape of the working edge, the angle of the working edge, and the "graspability" of the tool.

Maximum dimension was found to be a function of breadth x thickness and therefore an assumed function of the ability of a tool to be grasped (Figs. 2, 5, 8, 10). On this basis, length was plotted against angle of the working edge of used pieces in order to determine ranges of these factors suitable for particular tasks. These ranges were then later used in a functional analysis of archaeological examples for which the same measurements and observations were made.

The experimental results have been outlined in terms of angle and dimension changes (Fig. 1). These, used in conjunction with edge shape and size characteristics, as well as use-wear type, provide a framework for functional analysis. A more detailed treatment of the experiments and their implications is provided in Morwood (1974).

The Sites

Four assemblages from the Auckland area were studied; one from an Archaic inland site at Tokoroa (N75/1), and three of different ages from Harataonga Bay,



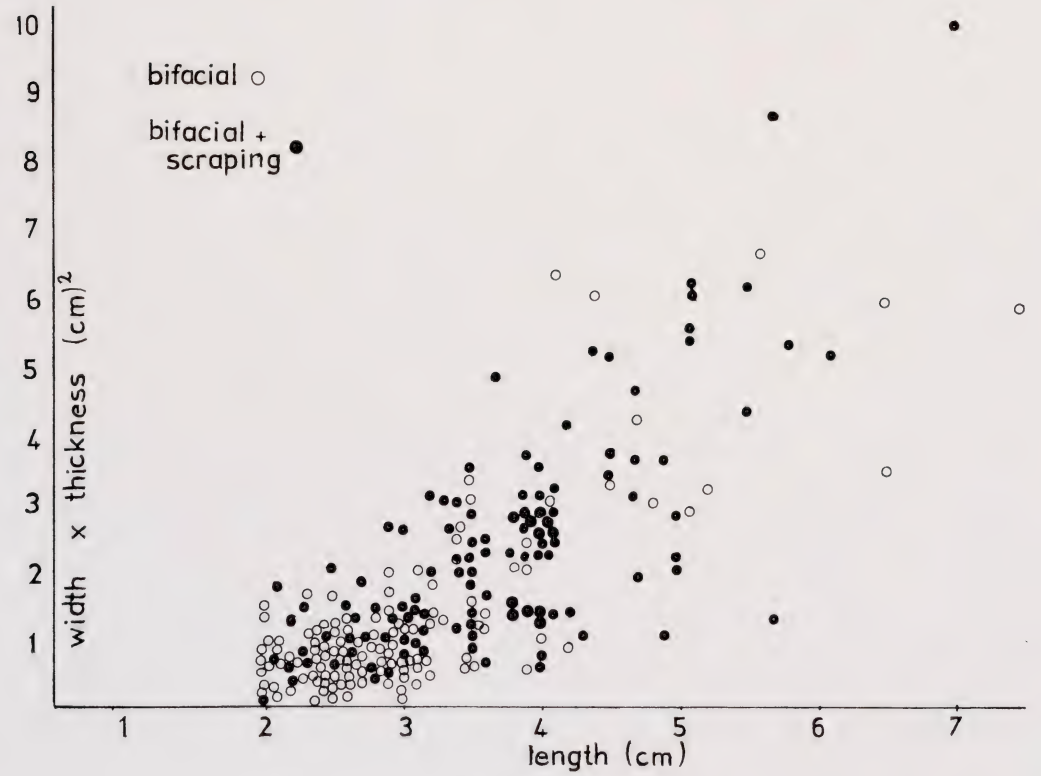


Fig. 2. Dimensions of obsidian from Tokoroa, N75/1.

Great Barrier Island (N30/3, N30/4, and N30/5). The choice was determined by practical considerations of the availability of the assemblages for study, but there were also theoretical considerations. The inland assemblage could be contrasted with the coastal sites to determine the effect (if any) of different environmental resources on flake tool morphology. A criticism of a functional analysis of flaked tools for interpreting economic activities has been made, "In addition, flaked stone tools appear to be machine tools rather than tools directly employed for food production . . . and therefore likely to continue to be used for similar tasks irrespective of the economy of their makers" (White 1971, p. 49).

This study was deemed a way of testing this criticism. Similarly the three coastal sites could be used to delimit cultural determinates of flake tool morphology given the same environmental resources. With experimentally established parameters, functional variation seems the easiest to isolate and allows the significance of cultural and technological differences to be gauged. This overcomes the naive assumption that differences between flake tool assemblages are of cultural significance only.

The method employed in the site analysis was to interpret the obsidian material using features earlier found to be significant. This was related to exploitation of resources evident at the site using ethnographic accounts where possible.

Tokoroa (N75/1)

One of the few early inland sites known from the North Island, the occupation has been assigned to the Settlement Phase for the area by Green (1970). This is supported by the high percentage of Mayor Island obsidian and the occurrence of moa at the site. The stratigraphy revealed formation of a podsol, indicating forest prior to the initial occupation. Most likely this would have been rimu forest now typical of the area. At the time of European contact, the vegetation in the area was predominantly scrub and fern, probably fire-induced. The food resources available to the first occupants of the area were, therefore, berries — *hinau, rimu, matai, kahikatea,* other vegetable foods, fungi and birds — pigeon, *kaka, tui, kiwi* and *moa* (Best 1907; Colenso 1880). The site was located on a small stream flat which would have provided minimal aquatic resources in comparison with, say, the Lake Ngaroto sites, where eels are thought to have been an important food source (Cassels 1972). The close proximity of the site to the stream, therefore, suggests the latter's value for movement or for water requirements rather than a source of food. This plus the diffuse nature of resources in an inland forest area would indicate a short occupation by people in transit. There is no evidence for any significant exploitation of potential forest foods as the faunal material is restricted to the remains of two (possibly three) moa of a small species, *Euryapteryx exilis.* In his report on the excavation Law (1973) has stated that the site was used for hunting moa. This is doubtful as the remains were of leg, toe and pelvic bones only, indicating that these birds were butchered elsewhere and brought to the camp from some distance.

The only artifacts recovered during the 1962 excavation were 510 pieces of obsidian and several adze flakes. The obsidian was sourced — 94% from Mayor Island — and has since been ignored. For this site, therefore, a functional analysis of obsidian tools is fundamental to understanding the activities undertaken during occupation.

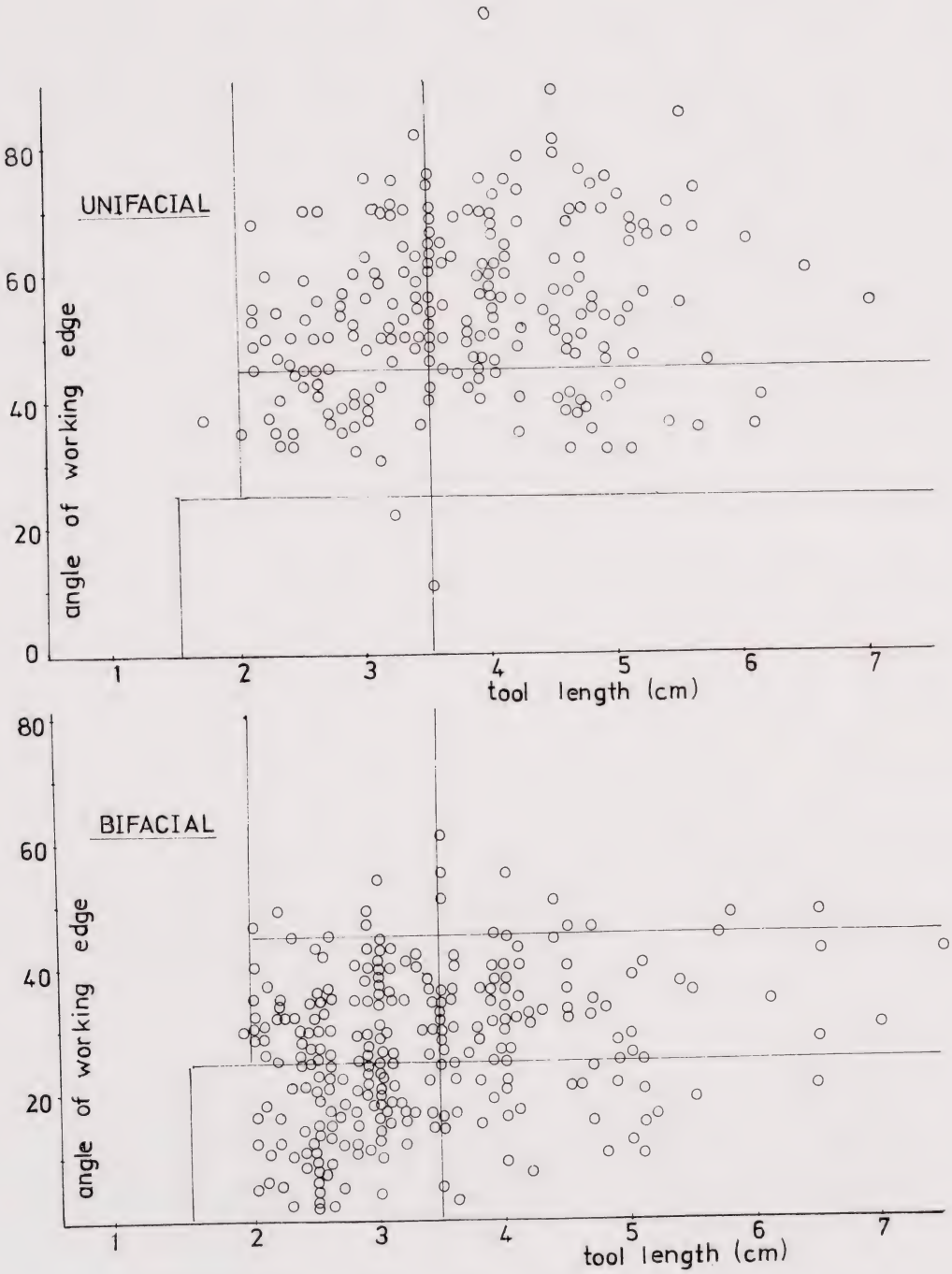


Fig. 3. Functional distribution of used obsidian from Tokoroa, N75/1.

Of the 409 pieces now available for study only 53 pieces (13%) showed no detectable sign of use and were categorised as not necessarily used (nn).

Graphs of length against breadth x thickness (Fig. 2) showed that not necessarily used obsidians clustered in the small size range, reflecting either functional discrimination against this size range or the difficulty in identifying use-wear in this category. The fact that the majority of used flakes also cluster in this area indicates the latter and it is likely that all of the obsidian recovered had been used. Certainly the high percentage of used obsidian plus the apparently opportunistic use, indicates that obsidian tool manufacture was carried out either at some unexcavated part of the site, or elsewhere. The size distribution of tools exhibiting unifacial and bifacial edge damage are similar but marked differences occur in the distribution of edge angles (Fig. 3). Obsidian experimentation has shown that these differences in angle distributions for the two types of edge damage result from the physical properties of obsidian rather than functionally or culturally determined choice. If an acute angled edge is used for scraping then it will incur bifacial edge damage (Fig. 4). If this factor is weighted for in the analysis, then it is found that the distributions of both scraping and cutting tools are similar, a fact consisent with both opportunistic use and the necessity of performing both operations in woodworking tasks. Functional significance can only be attributed to the differing angle distributions if a perfect unifacial/scraping, bifacial/cutting correlation is assumed, and experimentally the assumption is not valid. This means that scrapers, associated with maintenance activities, are under-represented if distinguished by unifacial edge damage. The frequency of co-occurrence of factors indicating scraping — unifacial damage, notching, and striations

Fig. 4. Obsidian showing the co-occurrence of bifacial edge damage and concavities indicating the working of shafts. Approx. actual size.

at right angles to the working edge — and bifacial damage was 42% (Table 1). As this represents the bare minimum frequency of co-occurrence, then obviously tasks involving both operations were a sizeable component of site activities, i.e. wood-working.

Table 1. Analysis of obsidian, N75/1.

	No.	%
Total no. studied	409	
No. showing use	356	87
No. of working edges	480	
No. showing bifacial damage	265	55
Co-occurrence of bifacial damage + scraping		42

Figure 3 can be interpreted using the experimental results. There is a minimum length of 2 cm for used pieces evident and this approximates the experimentally determined minimum for hand-held use. This may be evidence that hafting was not a feature of this assemblage, which is supported by the fact that the severity of edge damage on all specimens does not exceed that expected from unhafted use.

The minimum 2 cm length of the material could also result from the excavation technique employed as the soil was not sifted (R. C. Green, pers. comm.). Once again this would demonstrate the difficulty in handling obsidian of less than 2 cm.

The length against angle of working edge distribution for bifacially damaged edges (Fig. 3) shows that the majority of tools are of light usage and light wood-working categories. This was supported by the co-occurrence of scraping criteria and the use-damage type, edge damage on specimens with edge angle greater than 25° was well defined and regular. All specimens were examined under 10 x magnification but no example of the matted appearance, characterising butchering use-wear, was found.

The distribution of working edge angles and tool length for unifacially damaged edges was at first puzzling for 70% of the points clustered in a region which experimentally had proved suitable for fine-scraping and burnishing. However, in reconstructing the diameters of wood that was worked, on the basis of edge contours, it was found these varied from 6-30 mm with most clustering about 15 mm in diameter. Scraping would, therefore, be primarily concerned with the removal of bark and soft sapwood rather than fibrous woody tissue.

The assemblage reflects a restricted range of maintenance activities rather than extractive, which is compatible with the minimal exploitation of forest resources that the faunal remains (or lack of) suggests. On this basis one would conclude that the occupation was a transient one. The Tokoroa site certainly presents a contrast to the Whakamoenga cave, Lake Taupo, site (Hosking 1962). There a basal Archaic layer contained the remains of small birds, rats, fish, tuatara, shells and moa while artifacts included an adze, bird spear tips, pumice, chert, greywacke and a small number of obsidian flakes and cores. Thus the Lake Whakamoenga cave site provides evidence of a wide range of activities, both extractive and maintenance, which were not represented at Tokoroa. However, there are other factors to be considered. The quantity of obsidian found indicates a level of maintenance activity not expected for a transient camp and the percentage of pieces showing use demonstrates that the tools

were not manufactured in the area excavated. The occupation may have been for longer then, than the food remains would indicate, for little trace need remain of exploitation of plant resources, while for forest birds Pike (1973) notes accounts of bones and entrails of birds being consumed: "Thus the absence of forest-bird bones on a site does not necessarily mean that the birds were not being eaten but just preserved elsewhere, or else the bones and entrails were being consumed as well leaving no trace" (Pike 1973, p. 5).

If so, then the site may have been a base camp (Binford & Binford 1969) and the activities represented in the excavated area could be only a small component of the total site activities. This idea is supported by the specialised nature of the assemblage and the amount of used obsidian recovered. Also, sporadic finds of adzes and a large obsidian core had previously been made at the site and these are not represented in the excavated assemblage.

The paucity of artifactual and faunal types may be due to the area chosen for excavation rather than a minimal occupation period. Ranapiri (1895) lists the methods of procuring birds that were used by the Maori, including various snares and spearing. The reconstructed size range of materials worked indicates particular emphasis on the working of shafts, and many of these are appropriate for use as spear-shafts. Whether this site was as specialised as the assemblage indicates or whether the excavated assemblage represents a specialised component of a much broader range of site activities depends on the nature of the sample taken.

Great Barrier Archaic Midden (N30/5)

This Archaic site is an area of midden just above the high tide level. Two of the three squares excavated in 1962 were stratified into an upper and lower layer separated by clean sand, while one test pit excavated in 1969 showed a stratigraphy of four layers. Law (1972, p. 85) has pointed out that on the basis of structural evidence the sterile sand layer does not necessarily mean a long occupation hiatus, while all the other test pits show only a single occupation. Similarly, the homogeneity of the assemblage and faunal remains indicate "a provenly single period assemblage" (Law 1972, p. 85).

The location of the site allows exploitation of a number of varied ecological zones: rocky shore environment, open water, coastal forest, fertile soils — either for fern root collection or agriculture. The faunal remains provide evidence that all these potential resource zones were exploited, while the assemblage demonstrates both the means of exploitation and the manufacture of necessary equipment at the site. As well as exploitation of the immediate environment there is evidence for outside contact — shell-fish species not found in the immediate vicinity are of importance to local resource distribution while the high percentage of Mayor Island obsidian has New Zealand-wide implications (Green 1964).

For the exploitation of the rocky-shore environment little equipment is needed except perhaps a wooden or bone implement for detaching some species, and flax bags. It is, therefore, not likely that this economic stratagem will be reflected in the archaeological assemblage, despite its importance for coastal sites.

The occurrence of one-piece fish-hooks and the high percentage of snapper (93%) in the midden demonstrate the importance of line-fishing, while broken unfinished hooks, tabs and cores show that hooks were manufactured at the site. A lure shank of moa-bone and a shell point show exploitation of pelagic species, e.g. kahawai, by trolling although no remains of such species were recovered. However, the effect of these manufacturing activities on the obsidian assemblage may have been minimal with drills of siliceous material and rhyolite abraders being used instead of obsidian, which is too brittle for effective bone-work. Law (1972, p. 97) notes one abrader of unusual wear consistent with shaping the wide curves of fish-hooks. Ethnographic accounts have stressed the importance of nets in Maori fishing and undoubtedly these would have been in use, although little archaeological evidence would be expected as netting was made by rolling vegetable fibres on the thighs (Best 1929, p. 10). The leather-jackets and butterfish in the middens must have been taken either by trapping (Witter 1969, p. 51) or with baited nets (Law 1972, p. 98). Of trap manufacture, Best (1929, p. 152) states "Some of the finest and neatest work on fishtrap making was that of the northern parts of the North Island — that is the folk who were able to procure as material the small long and pliant stems of the climbing fern called 'mangemange'," while slender stems 3/10 to ¼ inch (7.6-6.3 mm) in thickness were used for hoops in eel pots. Thus trap-making need involve only obsidian of the light usage category if used.

The butchering pattern exhibited by fish bone frequencies is no longer reconstructible. At Galatea Bay, Ponui Island, Shawcross (1967, p. 113) showed that there was a higher proportion of snapper head bones than body bones. This he suggests may be due to preservation by drying of the bodies which were taken elsewhere for consumption. Allo (1970, p. 91) suggests, instead, that the high frequencies of head bones both at Galatea Bay and Station Bay, Motutapu, may be due to differential survival. If eaten on the spot fish could have been prepared whole or merely gutted; the most one would expect from this, if obsidian was used, would be limited bifacial damage while the limited depth of penetration required for gutting means that any pieces of obsidian longer than 1.5 cm with a straight or convex edge less than 25° would suffice. However, if preparation involved removal of the head, as for preservation, then obsidians with the characteristic butchering pattern should occur.

Sea-coastal birds which were the majority of avifauna represented in the midden (75%) may have been taken during the breeding season or stranded on beaches at other times (Pike 1973), in either case minimal technology was required for exploitation. Forest birds may have been taken in three main ways (Ranapiri 1895) — by noose, snares at drinking troughs, or speared. The most efficient way was use of snares made of twisted fibre, but one bird spear tip was recovered and spear manufacture would have involved barking and smoothing of a shaft, i.e. burnishing/barking functional category.

Downes (1928, p. 9) records that bird bones and entrails were sometimes consumed but in Richdale's (194—, pp. 100-104) description of the preparation of mutton birds on Stewart Island, the feet were severed between tarsus and leg, the wings cut off above the humerus and the head and tail removed. The latter procedure would result in limited bifacial edge damage and possible striae and dulling. Whether this was done in the immediate vicinity of the site or elsewhere is relevant to the excavated assemblage, for the midden documents the pattern of disposal rather than the full range of activities carried out by the site occupants.

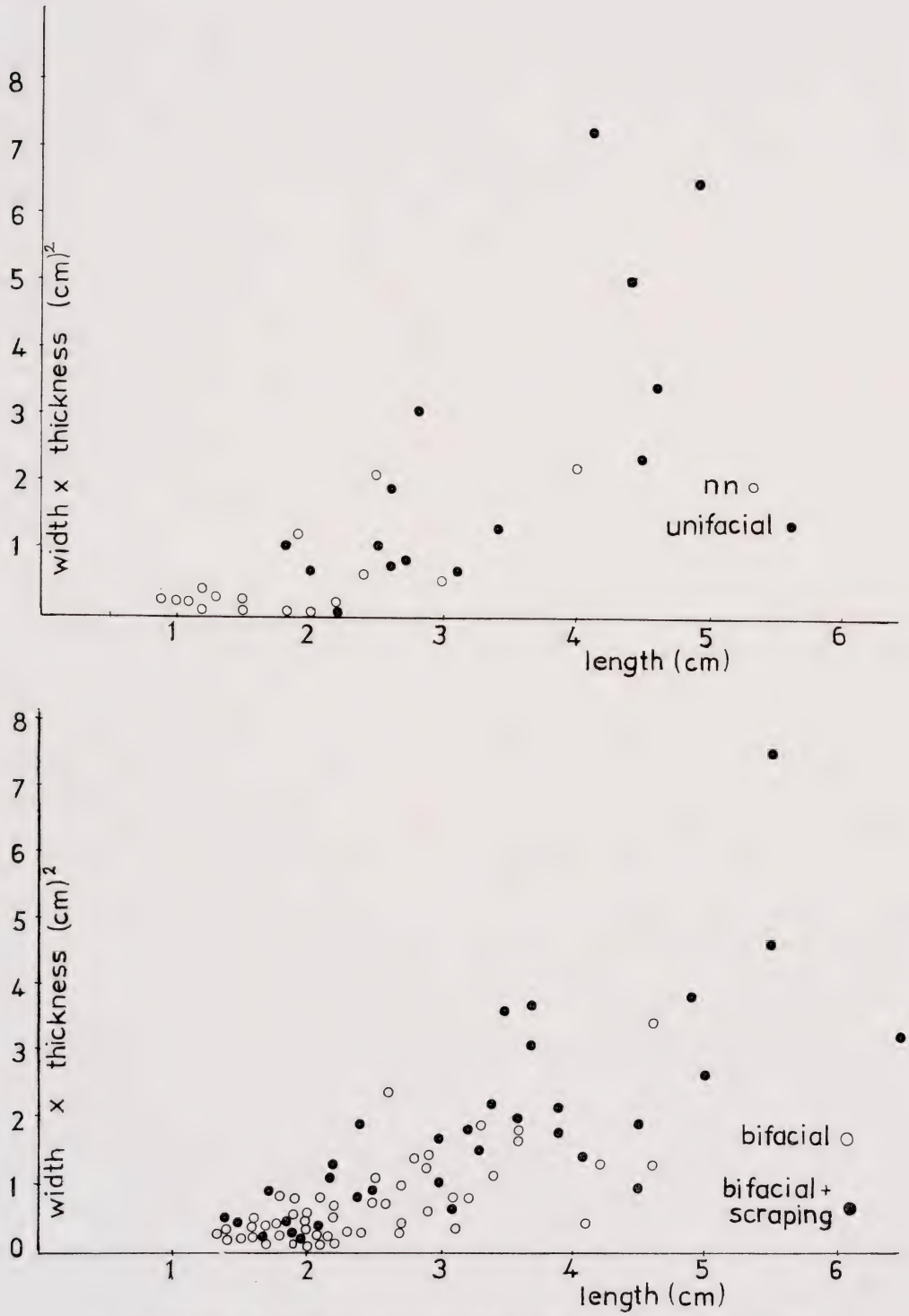


Fig. 5. Dimensions of obsidian from Great Barrier Archaic midden site, N30/5.

A skin burnisher (?), a needle, and awl, together with the remains of dog, seal, and moa, show that butchering and dressing was done at the site. Hence both skin scraping and heavy butchering functional factors are relevant to a use damage study at this site.

Stephen Edson of Auckland University (pers. comm.) has evidence for extensive agricultural systems associated with an Archaic culture on Great Mercury Island. Therefore, since pits on later sites in Harataonga Bay attest to the fertility of the area, some heavy woodworking could be expected in the manufacure of digging equipment for agriculture or fern root gathering. A final fact to consider is that the degree of social elaboration evident by the occurrence of a tattooing chisel, skin burnisher, etc, indicates an amount of leisure time which may have been invested in carving. This too could be reflected in the obsidian assemblage.

A comparison of graphs showing the size distribution of N30/5 obsidian (Fig. 5) and the Tokoroa material (Fig. 2) demonstrates the subjectively defined "heaviness" of the Tokoroa obsidians. On average the obsidians from all the coastal sites are smaller and the edge wear is less severe than that from Tokoroa (Fig. 6).

The size graph for N30/5 (Fig. 5) shows that pieces designated as "unused" are clustered in the small size range. Eighty-seven per cent of the obsidian was identified as used, exactly the same percentage as for Tokoroa, and, therefore, it would seem that the 13% of "not necessarily used" in these assemblages results from the difficulty in identifying use of small acute angled tools (Fig. 6).

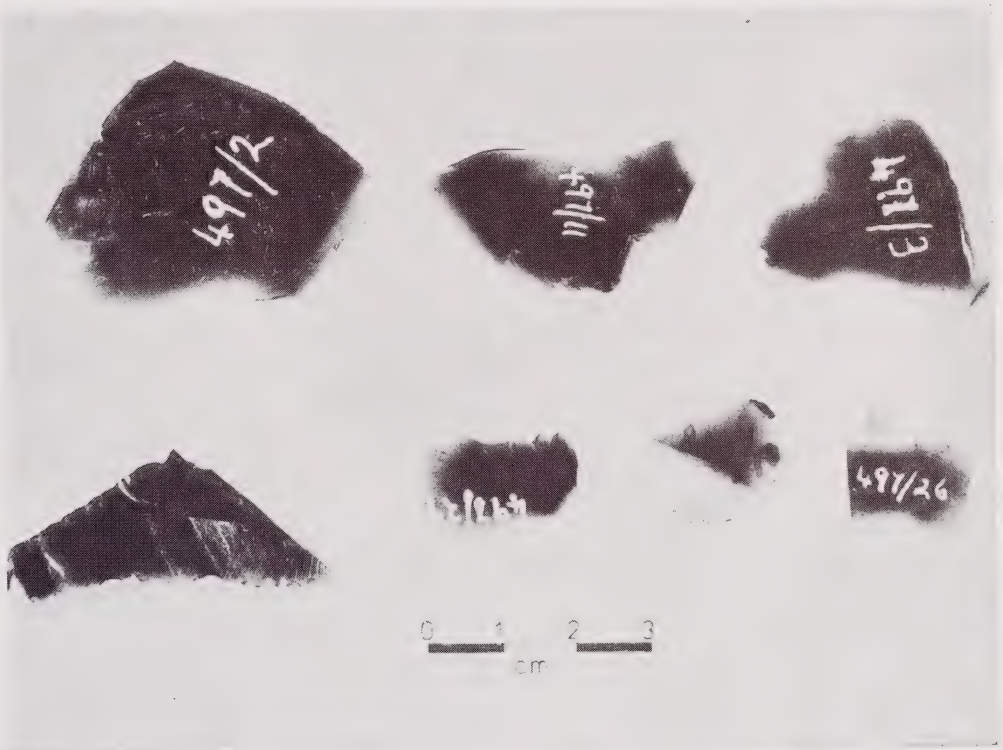


Fig. 6. Obsidian showing smaller size range and less severe edge wear, typical of Great Barrier coastal sites N30/5, N30/4 and N30/3.

As scraping is a feature of maintenance activities the reduced ratio of unifacially damaged/bifacially damaged edges and their reduced co-occurrence to 29% (c.f. 42% for Tokoroa) indicates an increase in light usage and food preparation activities (Table 2, Fig. 7). This is expected in a comparison between both the potential food resources and midden remains from Tokoroa and Harataonga Bay. However, microscopic examination did not reveal any positive criteria of butchering and it is suggested that food preparation did not involve procedures necessary for preservation, e.g. fish-head removal. This supports Allo's rather than Shawcross's argument concerning the frequency of fish-head bones in middens (Allo 1970, p. 91; F. W. Shawcross 1967, p. 113). Archaic economy, therefore, may have been coastal based all year round in contrast to later accounts. For example, K. Shawcross (1967) records that there was a seasonal migration from interior to coast by one-third of the Bay of Islands population.

Table 2. Analysis of obsidian, N30/5.

	No.	%
No. of pieces studied	116	
No. showing use	101	87
No. of working edges	116	
No. of edges showing bifacial damage	90	78
Co-occurrence of bifacial damage + scraping criteria		29

The high percentage of used obsidian, which is probably a conservative figure, implies that the manufacture of obsidian tools, and probably the use, did not occur in the excavated area. Jones (1972) has suggested that obsidian was dumped in places where it was not likely to be trodden on. If this is correct then the excavated area was for refuse disposal rather than a living area, an interpretation supported by the non-functional condition of the formal artifact types recovered. The only evidence for use of the excavated area other than for dumping was in the upper layer of square B2 where an oven and adjacent lens of clay were found: only one piece of obsidian came from this level. The laying down of 20 cm of clean sand under this then, may mark a temporary change in the use of one portion of the site rather than an occupation hiatus.

In contrast to the other sites studied the flake assemblage from N30/5 was not predominantly of obsidian, but also comprised 228 basalt flakes and 223 siliceous flakes. Basalt is a homogeneous, partially vitreous, tougher material, but working edges are not as sharp as those of obsidian and, while siliceous materials are homogeneous, tough and sharp, they lack the keenness of edge found in obsidian (Crabtree & Davis 1968, p. 427 for a table of properties). It is hard to assess the effect that the availability of these other materials may have on the obsidian component of an assemblage, but their properties make the materials more suited to heavy woodworking and bone working in particular, than obsidian which is brittle.

Great Barrier Beach Midden (N30/4)

Located on a natural terrace behind the beach, this site is an area of diffuse midden, several ovens and a line of fifteen post-holes running along the outer edge of the terrace. The site, therefore, was used primarily for food preparation, a fact consistent with the paucity of artifactual material — thirteen pieces of obsidian, two siliceous flakes, a piece of worked bone and two dentalium shell sections. The

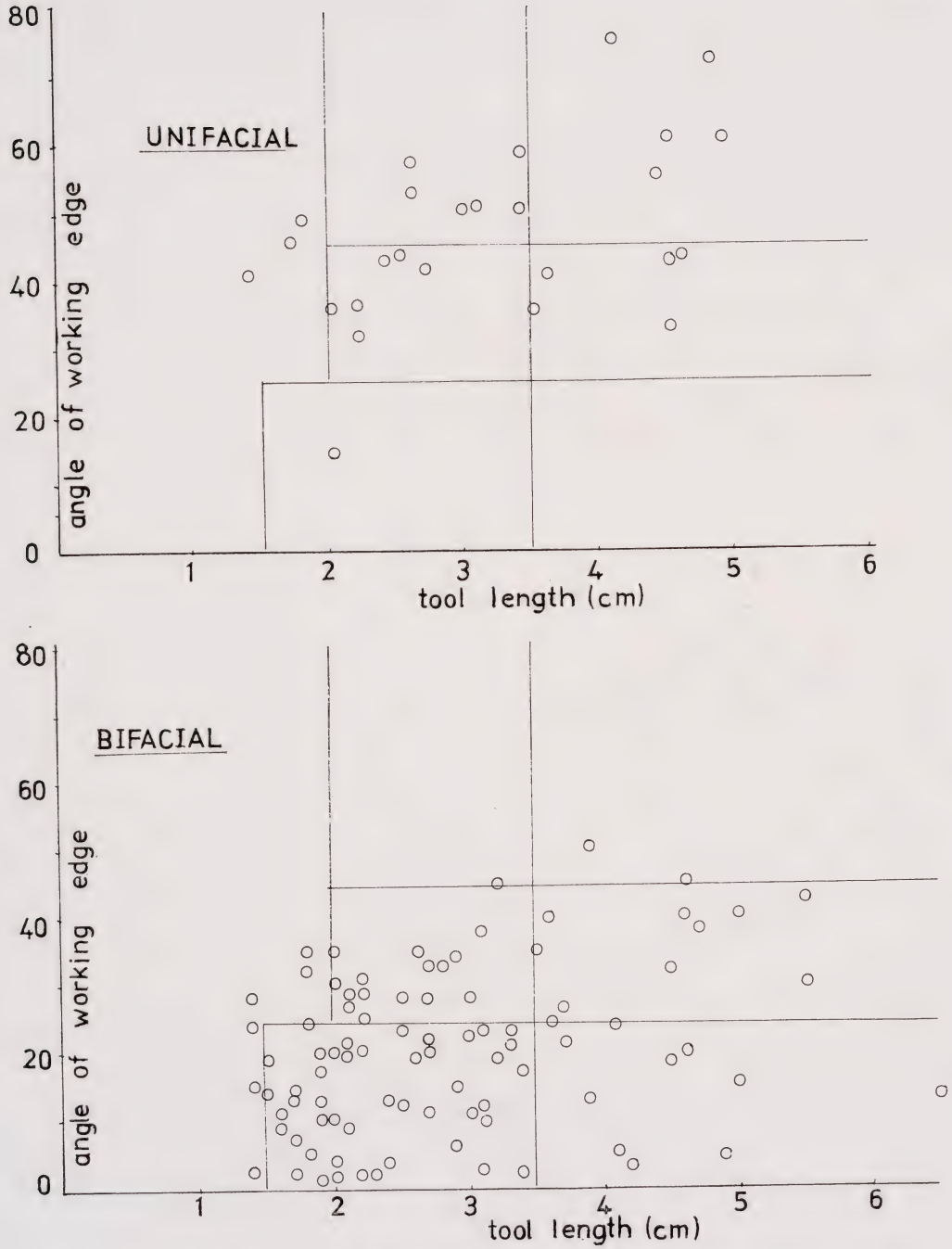


Fig. 7. Functional distribution of used obsidian from Great Barrier Archaic midden, N30/5.

stratigraphy was basically a layer of diffuse midden of variable depth overlaying white beach sand into which ovens had been dug. An earlier restricted cultural deposit is not significant to the assemblage as all the material recovered was from the final occupation.

Law (1972, p. 110) has argued that this site is later in the sequence than N30/5 on the basis of its specialised nature, and the absence of Archaic artifacts and extinct birds. Dates are now available for the Harataonga sites (Law 1974). N30/5 is indirectly dated to the 13th century A.D. by association with Loisel's pumice, while the other sites have been dated by 3 radiocarbon age determinations. Two results from N30/4 yield a pooled mean of 231 $\pm$ 40 B.P. which gives a best age of A.D. 1610-1660 at one standard deviation. At N30/3 a single date from a burnt post at the base of the pit fill is 441 $\pm$ 55 B.P. which gives a best date of 1390-1440 at one standard deviation.

All but one of the nine pieces of obsidian studied showed signs of use (Table 3), and it is noticeable in Figure 8 that this unused piece differs significantly in its length x breadth measurement. This specimen is also water-worn and it may have been

Table 3. Analysis of obsidian, N30/4.

	No.	%
No. of pieces studied	9	
No. showing use	8	89
No. of working edges	8	
No. of edges showing bifacial damage	7	87.5
Co-occurrence of bifacial damage + scraping		28

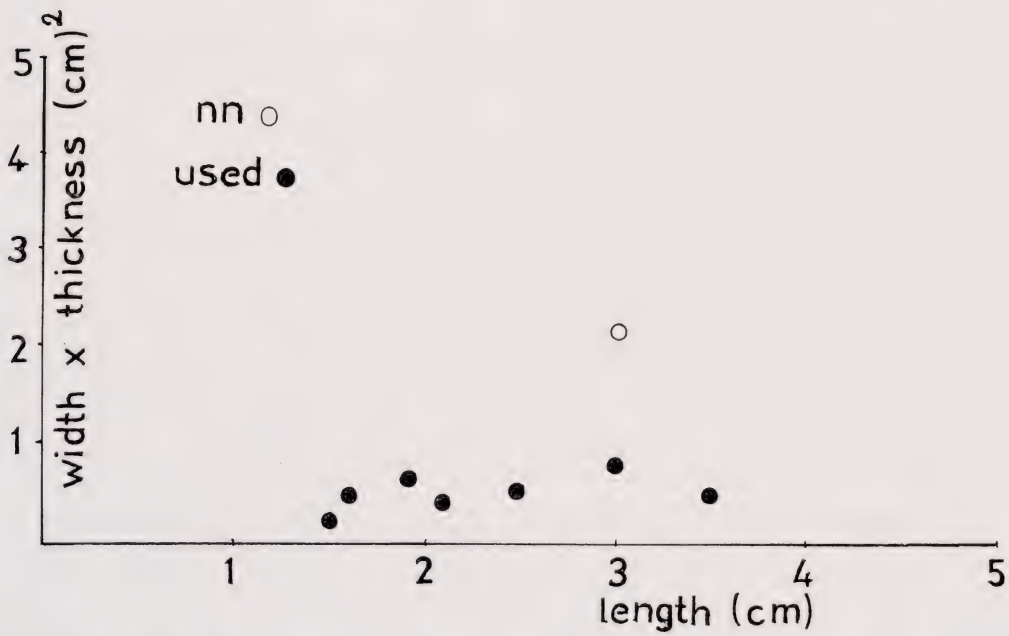


Fig. 8. Dimensions of obsidian from Great Barrier beach midden, N30/4.

eroded out of an earlier site and kept by the inhabitants of N30/4 for future use. All of the bifacially damaged tools fall into the light usage category, suggesting light manufacturing activities and gutting. This is consistent with the one unifacially damaged tool being suitable for light woodworking while the two edges from which dimensions of the worked material are reconstructible show the working of shafts some 6 mm in diameter. The functionally specialised nature of the obsidian assemblage mirrors the functional specialisation of the site, while the range of angle and length values is appropriate to the range of activities indicated by other evidence, i.e. food preparation and some manufacturing. The tools are definitely not suited for heavy wood or bone work and also lack the severity of edge damage which would be associated with this. The presence of a piece of worked seal bone indicates a limited amount of bone working was carved out at the site and the two siliceous flakes may have been used for this. In comparing the Archaic site N30/5 with N30/4 it is noticeable that the marked decrease in the occurrence of siliceous material parallels a marked decrease for evidence of bone working.

Law (1972, p. 106) reports that the obsidian from this site averaged less than one-third of the size of obsidian from N30/5 and a comparison of the dimension graphs for both sites (Figs. 5, 8) amply demonstrates this. This analysis demonstrates that the difference is of functional rather than cultural significance (Fig. 9).

The midden material from N30/4 shows a greater reliance on shell-fish and a substantial reduction in the variety and number of birds in comparison with N30/5. The difference, however, is a change of degree rather than kind and the sites show similar economic strategies and presumably, therefore, similar activities were involved

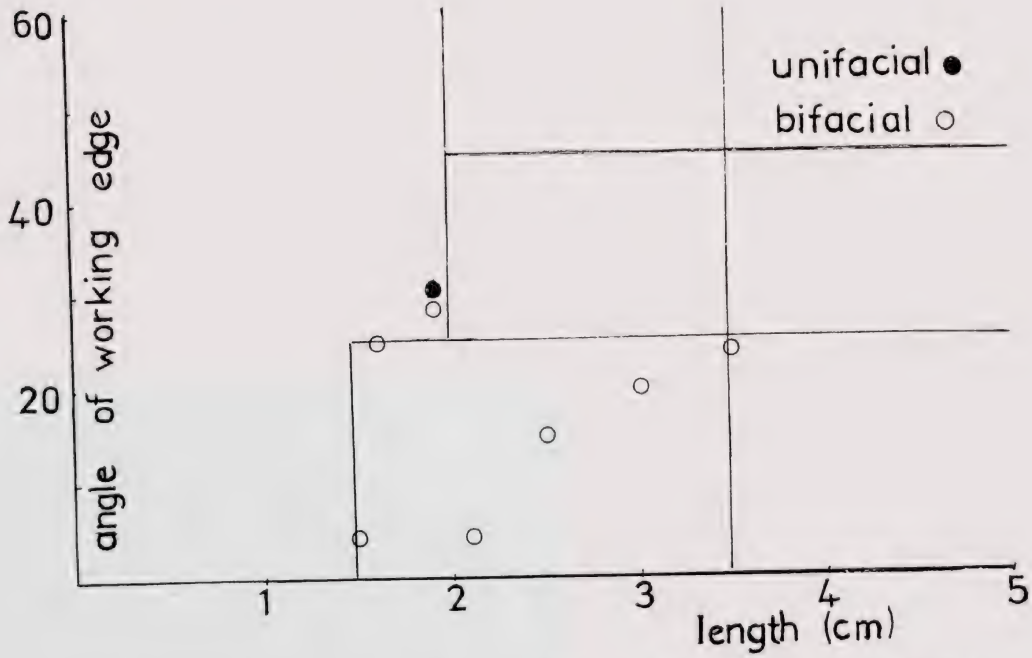


Fig. 9. Functional distribution of used obsidian from Great Barrier beach midden, N30/4.

in resource exploitation. Once again, as at the Tokoroa site, the question of archaeological sampling, as well as the distribution of past activity areas, is basic to a reconstruction of prehistoric behaviour.

Great Barrier Pa (N30/3)

This is a small pa site on a low headland above N30/4. There is a single defensive ditch and only one pit evident, though others have possibly been covered by sand. Excavation revealed a complex stratigraphy and, therefore, site history, involving 6 layers, but as all but one piece of obsidian derived from the top layer this is not really relevant to the excavated assemblage. Besides obsidian the assemblage included a worked piece of dog mandible, six worked pieces of albatross bone, a piece of basalt boulder, fossilised wood, kauri gum, red and orange ochre and eighteen flakes of siliceous material.

The high percentage of "unused" obsidian contrasts with the percentages obtained for the other sites and this, plus the recovery of one large obsidian core, suggests that here obsidian tools were being manufactured as well as used (Table 4). The unused obsidian was of small size (Fig. 10), a feature expected of industrial waste, and this plus its numerical significance explains the fact that average size by weight was smaller than for N30/5. The differing size distribution of obsidian from these sites is, therefore, primarily due to a difference in site use. The small ratio of unifacially/bifacially damaged edges and the 28% co-occurrence of bifacially damaged edges and scraping criteria indicates light woodworking and light usage activities (the reconstructed size range of worked materials shows all to have been 1 cm or less in diameter). Bone working evident at the site was probably carried out using siliceous material. As with the other sites the broad distribution of angles for unifacial and bifacial edge damage conforms to experimentally-derived predictions and unifacially damaged edges are, with few exceptions, greater than 25° (Fig. 11).

Table 4. Analysis of obsidian, N30/3.

	No.	%
No. of pieces studied	169	
No. showing use	74	44
No. of working edges	87	
No. of edges with bifacial damage	67	77
Co-occurrence of bifacial damage + scraping		28

Microscopic examination of the assemblage revealed that at least two specimens (Catalogue Nos. AU969/44, AU963/67) had longitudinal and transverse striations which, together with evidence of depth of penetration, indicated use for butchering. This type of activity and the use-wear severity was not consistent with hand-held use for tools of the size in question (1.5 cm maximum dimension). Although further examples of this use-wear type were not identified, the size distribution of light cutting specimens suggests that obsidian of this size and angle range may have been elements in a composite tool in the same way that sharks' teeth are known to have been hafted, for example, Hamilton (1908, p. 71) reports that sharks' heads were cut off with a sharp-toothed knife, made from sharks' teeth set in and tied tightly to a wooden handle. Evidence of a different type of hafting was found on a specimen

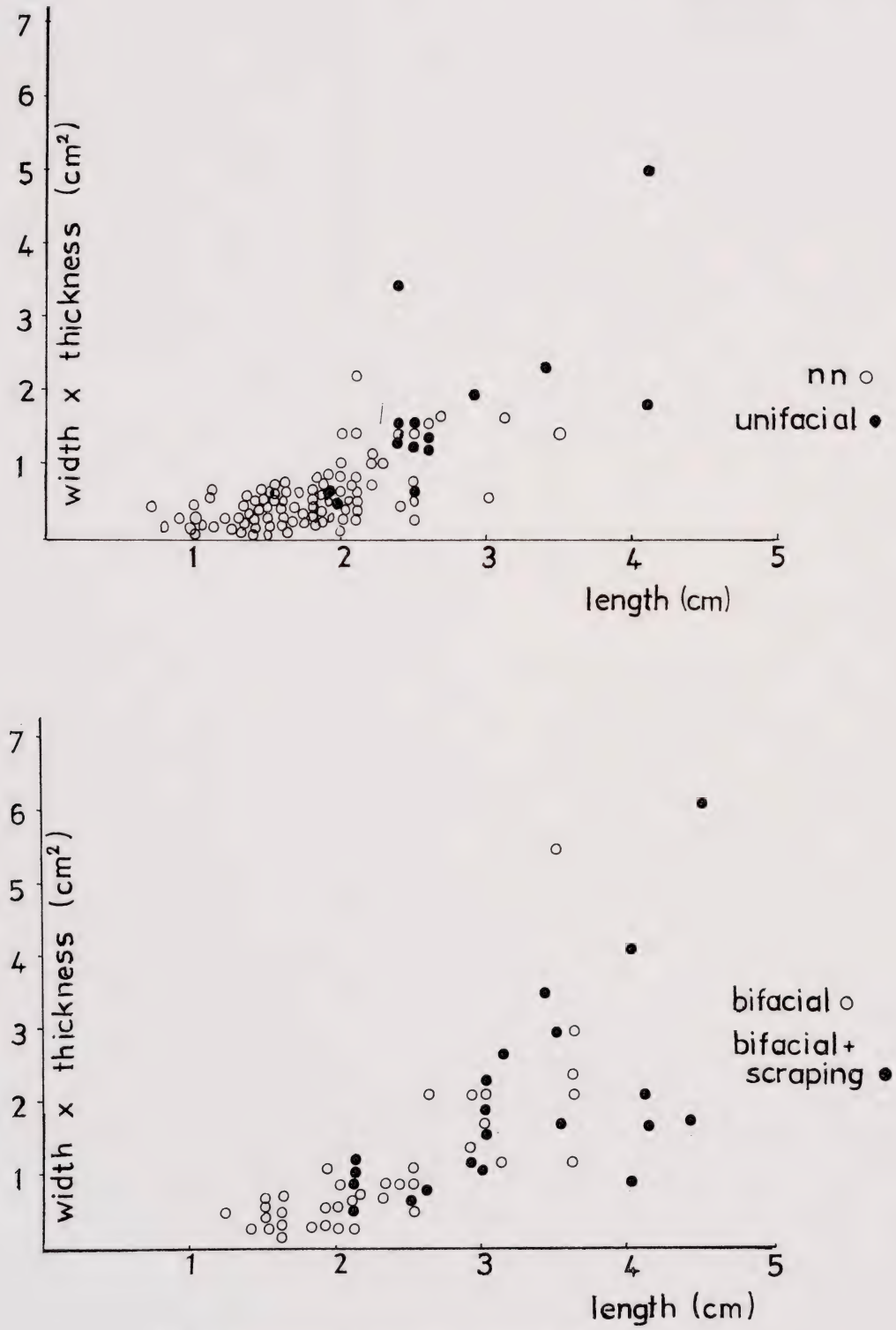
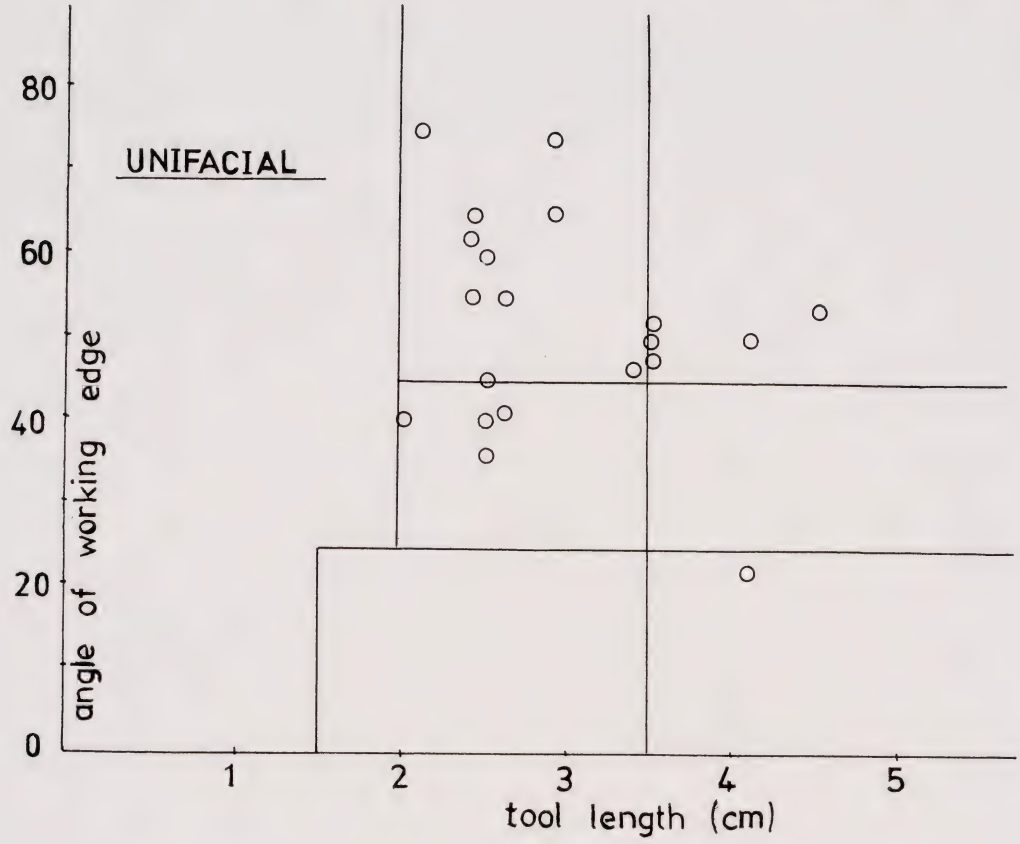


Fig. 10. Dimensions of obsidian from Great Barrier pa site, N30/3.



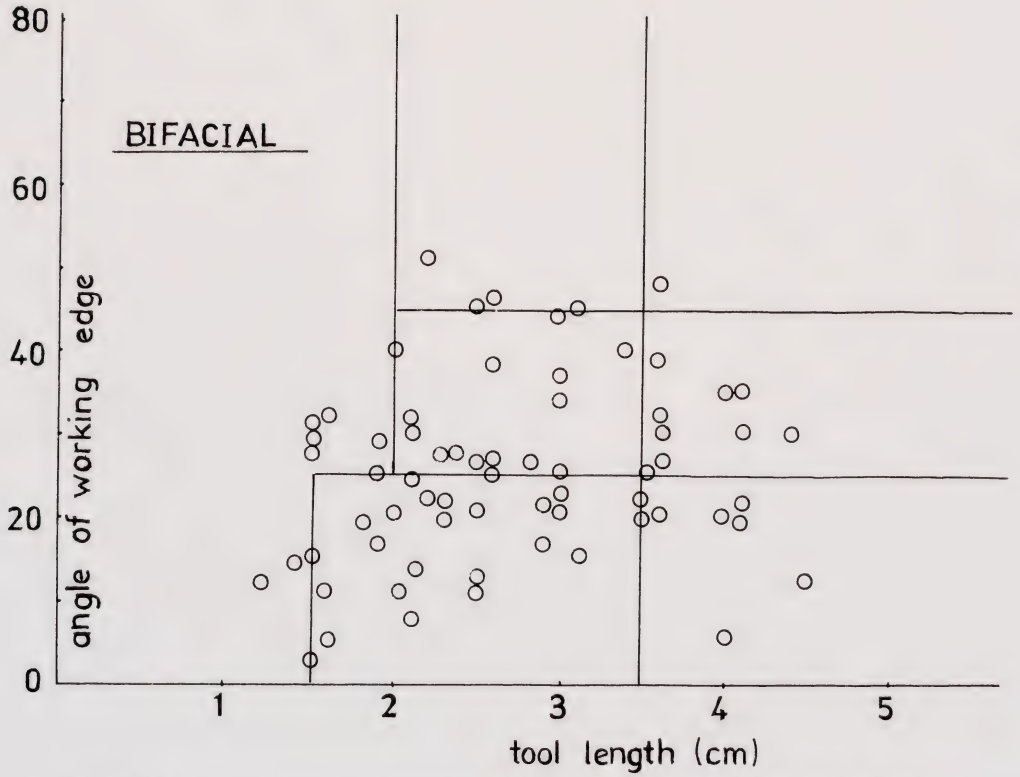


Fig. 11. Functional distribution of used obsidian from Great Barrier pa site, N30/3.

Fig. 12. Obsidian tool, specimen No. AU949/5. Maximum dimension 1.5 cm. Heavy edge damage is not compatible with hand held use, while lateral crushing (arrowed) shows contact with haft.

from the light woodwork functional category (Fig. 12). This specimen (AU949/5) is a micro-blade (maximum dimension 1.5 cm) with heavy unifacial damage at the distal end. The severity of edge damage is far greater than expected for a tool of this size and microscopic examination revealed minute lateral crushing of the edges where the obsidian made contact with the haft. Wilmsen (1968, p. 161) has described the lateral crushing of scrapers where the haft met the tool.

Some ethnographic accounts indicate extremely casual types of "hafting" such as holding the tool in grass or a dry leaf to increase grasping ability (Harry Allen pers. comm.). Identified examples of hafting may constitute only a small number of the specimens hafted in prehistoric times. Since hafting was a feature of this assemblage then this culturally significant feature could also affect functional categories.

The distribution of obsidian through the stratigraphy has interesting implications. The basal levels of the pit document use of the pit for storage, while the digging of two ovens and the later accumulation of diffuse midden shows use of the pit for cooking and possibly as a living area. Evidence of use of the pit for a variety of activities contrasts with the fact that only one piece of obsidian was recovered from those levels. The majority of obsidian was obtained from the top layer and it is

suggested that it was deposited after use of the site for other activities had ceased. The high frequency of obsidian in or just under the top-soil seems a feature of many Auckland terrace sites and is evidence for the pragmatic separation of living areas and areas for obsidian tool manufacture and disposal.

Inter-site Discussion and Comparisons

The analysis of flaked material from the four sites demonstrates that White's thesis (see p. 80) is only partially correct. Flaked tool assemblages are sensitive to differing patterns of activity and can, therefore, provide evidence of economic type. Consideration of each site in isolation has yielded information on site activities and has implications for any future technological studies that may be performed on the materials. For instance, a technological study which did not take into account the high percentage of "unused" obsidian at N30/4, or the functionally specialised nature of the assemblage from N30/4, would demonstrate a significant difference in size between obsidian from these sites and the Archaic sites N75/1 and N30/5. Assuming that the differences were culturally determined, one would conclude that Archaic sites are distinguished by the relatively high proportion of large obsidian tools. A functional analysis shows that this conclusion is not valid (on the basis of the four sites investigated) but occur because of the uncritically descriptive nature of the approach.

Six functional categories were used for inter-site comparison based on the experimental results (Morwood 1974). These were as follows.

(1)	Light usage I	(<25°) ∪	(1.5 - 3.5 cm)
(2)	Light usage II	(<25°) ∪	(>3.5 cm)
(3)	Light woodworking	(25 - 45°) ∪	(2 - 3.5 cm)
(4)	Wood-working	(25 - 45°) ∪	(>3.5 cm)
(5)	Burnishing/barking I	(>45°) ∪	(2 - 3.5 cm)
(6)	Burnishing/barking II	(>45°) ∪	(>3.5 cm)

Although there is definite evidence of hafting in at least one assemblage (N30/3), the 3.5 cm length, which experimentally was shown to be the minimum for an unhafted power grip, was maintained. This was not only because most tools have edge-wear consistent with hand-held use but also because of the implication for prehistoric resource conservation and technology. For example, hafting may be shown by the presence of small tools with heavy edge damage.

Table 5 shows numerical and percentage differences between functional categories of the various sites. Chi-squared tests of significance showed that some differences

Table 5. Summary of the site analyses.

		Functional categories					
		1	2	3	4	5	6
Tokoroa:	Number	81	28	102	86	63	120
	Percentage	(16.9)	(5.8)	(21.2)	(17.9)	(13.2)	(25.0)
N30/5	Number	49	11	26	14	9	7
	Percentage	(42.2)	(9.5)	(22.4)	(12.2)	(7.8)	(6.0)
N30/4	Number	6	—	2	—	—	—
	Percentage	(75)	—	(25)	—	—	—
N30/3	Number	23	12	19	14	11	8
	Percentage	(26.4)	(13.8)	(21.8)	(16.1)	(12.7)	(9.2)

apparent between the assemblages were significant or highly significant. Of particular interest were the highly significant differences between the Archaic sites of Tokoroa and N30/5 in Classes 1 and 6. The obsidian components of these flake tool assemblages then, do reflect the use by similar cultural groups of different environmental resource zones. The significant difference in Class 1 between the coastal sites of N30/5 and N30/3 documents the more specialised nature of activities at N30/3. The paucity of material from N30/4 and its restricted functional distribution is itself of importance but meant this could not be quantitatively tested. However, basic to the analysis is that obsidian use was selective. By negating the element of chance and using experimentally defined functional ranges in the analysis, differences are of assumed functional significance. A complication arises, however, in that chance is inherent in archaeological sampling techniques, and a major criticism of this analysis is that it is not based on total excavation of the four sites. The thesis that past behaviour can be reconstructed by partial excavation is dubious and seems incompatible with the task dispersal inherent in the concept of "activity" areas. To overcome this the excavated assemblages have been treated as total assemblages.

Difficulty was encountered in attempting to quantify intersite differences both for definition of cultural and environmental determinates of flake tool morphology and to derive a functional weighting factor for a technological study: of importance to a reconstruction of site activities is the distribution of parameters used in the study and if the distribution is summarised for intersite comparisons the procedure is self-defeating. Robinson similarity indexes were calculated for each pair of sites and the results arranged in an ideal Robinson matrix in which coefficient values steadily increase toward the diagonal along any row or column (Frost 1970, p. 194 for a discussion of similarity indexes and their use). Although the analysis showed that the obsidian assemblages from Tokoroa and sites N30/5 and N30/3 on Great Barrier were similar in their functional distributions, a functional interpretation based on obsidian tools only is misleading as basalt and siliceous flake predominance at N30/5 shows an intensity and range of manufacturing activities not present at the other sites. The more restricted range of artifacts and their specialised nature at the other sites then, may relate to their relatively impoverished environments; certainly cultural considerations seem peripheral. At Tokoroa this is related to the diffuse nature of the forest resources, while the separation and dispersal of activity areas in the later coastal sites (N30/4, N30/3) seems based on pragmatic rather than cultural factors, that is, the resulting patchiness of a man-modified environment. Use-wear on some obsidian from N30/3 is consistent with fish-head removal as would be required for preservation, and later groups may not have been coastally based all year round. Once again, however, resources depletion rather than cultural factors can explain the difference.

Acknowledgements. I should like to thank the Director of Auckland Institute and Museum for the opportunity and facilities to study the four assemblages in the archaeology collections. I should also like to thank Prof. R. C. Green of the University of Auckland for his considerable help, Dr Harry Allen (University of Auckland) and Gary Law (Auckland) for their comments and criticisms, and Cyril Schollum for the photographs which appear in this article.

REFERENCES

ALLO, Jan

1970 Analysis of midden from two sites on Motutapu Island, New Zealand. *Rec. Auckland Inst. Mus.* 7: 83-91.

BEST, Elsdon
1907 Maori forest lore. *Trans. Proc. N.Z. Inst.* 40: 185-254.
1929 Fishing methods and devices of the Maori. *Bull. Dominion Mus.* No. 12: 1-230,

BINFORD, L. F. and S. R. BINFORD
1969 Stone tools and human behavior. *Scientific American* 220 (4): 70-84.

CASSELS, Richard
1972 Locational analysis of prehistoric settlement in New Zealand. *Mankind* 8 (3): 212-222.

COLENSO, William
1880 On the vegetable foods of the ancient New Zealanders before Cook's visit. *Trans. Proc. N.Z. Inst.* 13: 3-38.

CRABTREE, D. E. and E. L. DAVIS
1968 Experimental manufacture of wooden implements with tools of flaked stone. *Science* 159: 426-428.

DOWNES, T. W.
1928 Bird snaring, etc., in the Whanganui River district. *J. Polynes. Soc.* 37: 1-29.

FROST, E. L.
1970 Archeological excavations on Taveuni. Ph.D. dissertation, University of Oregon, Eugene.

GREEN, R. C.
1964 Sources, ages and exploitation of New Zealand obsidian. *N.Z. Archaeol. Ass. Newsl.* 7 (3): 134-143.
1970 *A review of the prehistoric sequence of the Auckland province.* University Book Shop, Dunedin, 60 pp. illus.

HAMILTON, Augustus
1908 Fishing and sea-foods of the ancient Maori. *Bull. Dominion Mus.* No. 2: 1-73.

HOSKING, T.
1962 Report on the excavation of Whakamoenga Cave, Lake Taupo. *N.Z. Archaeol. Ass. Newsl.* 5 (1): 22-30.

JONES, K. L.
1972 Prehistoric polynesian stone technology. Unpublished M.A. thesis, University of Otago.

LAW, R. G.
1972 Archaeology at Harataonga Bay, Great Barrier Island. *Rec. Auckland Inst. Mus.* 9: 81-123.
1973 Tokoroa moa-hunter site, N75/1. *N.Z. Archaeol. Ass. Newsl.* 16 (4): 150-164.
1974 C14 dates from Harataonga Bay, Great Barrier. *N.Z. Archaeol. Ass. Newsl.* 17 (in press).

MORWOOD, M. J.
1974 Experiments with obsidian; functional and typological implications. Unpublished research essay, University of Auckland.

PIKE, Brigid
1973 A prehistoric ornithology. Unpublished research essay, University of Auckland.

RANAPIRI, Tamati
1895 Ancient methods of bird-snaring amongst the Maoris. *J. Polynes. Soc.* 4: 132-152.

RICHDALE, L. E.
194– *Maori and muttonbird.* Wild life series, No. 7, Otago Daily Times and Witness Newspapers Co. Ltd, Dunedin. 16 pp.

SEMENOV, S. A.
1964 *Prehistoric technology.* Cory, Adams and Mackay, London. xii 211 pp. illus.

SHAWCROSS, F. W.
1964 Stone flake industries in New Zealand. *J. Polynes. Soc.* 73: 7-25.
1967 An investigation of prehistoric diet and economy on a coastal site at Galatea Bay, New Zealand. *Proc. Prehist. Soc.* 33: 107-131.

SHAWCROSS, Kathleen
1967 Fern-root and the total scheme of 18th century Maori food production in agricultural areas. *J. Polynes. Soc.* 76 (3): 330-352.

WHITE, J. P.
1971 New Guinea: the first phase in Oceanic settlement. In *Studies in Oceanic culture history.* R. C. Green and M. Kelly (Eds.) No. 12 Pacific Anthropological Records, Bishop Museum, Hawaii. pp. 45-52.

WILMSEN, E. N.
1968 Functional analysis of flaked stone artifacts. *Am. Antiq.* 33: 156-161.

WITTER, D.
1969 Notes on the significance of the leather jacket in middens. *N.Z. Archaeol. Ass. Newsl.* 12 (1): 51.

A LINTEL FROM SOUTH KAIPARA HEAD

D. R. SIMMONS
AUCKLAND INSTITUTE AND MUSEUM

In 1971, Daniel Quigley found a carved door lintel in a drainage channel on his father's farm on the South Kaipara Head near Helensville at the place marked by grid reference 854885 on map N37 NZMS1, Helensville. The channel had been excavated some ten feet (3.04 m) into the peat and a section of the channel wall had fallen into the centre of it as a unit. The lintel came from a carefully prepared bed of raupo about thirty centimetres from the top of the collapsed block. Originally, the lintel had been placed just below the surface of the peat and about twenty centimetres from the then surface. A small indentation had been made and lined with raupo, the lintel placed in it and covered with more raupo leaves. Then some of the peat had been replaced to cover both the lintel and raupo. The rising flood waters from a brief period of rain floated the lintel free while the raupo bed remained intact. Daniel Quigley reported his find immediately. Consequently little water damage was done to the lintel and the fallen block from the wall was still mainly intact though it had lost about a third of its lower portion.

The lintel (Fig. 1) is 81.5 cm long at the top and 21.7 cm long at the bottom with a height at the centre of 26.3 cm. It consists of a central female figure with rectangular body. The arms are represented as bars at the side of the body and there are three pointed fingers on the stomach on either side. The legs are not represented but there are feet on either side of the vagina. The head has a high domed forehead with oblique eyes and a mouth which is rounded and open. At the eyebrows the head is 8.2 cm wide while the mouth is 12 cm wide. All the head above the mouth projects above the line of the lintel.

Either side of the central figure are spirals: the one on the left has a raised centre line with groups of crescent lines either side; the one on the right has a groove in the centre with grouped crescents spanning the whole width. Both spirals have been pierced, though in two cases this had not been completed at the bottom. The terminals are manaia, the upper jaw of which is repeated as a toothed decoration down the sides.

The lintel has no flange at the back but has four lashing holes along the base. The piece was certainly carved with stone tools. The wood is probably kauri.

The lintel is remarkable for its domed central figure and the toothed decorations at the side. The overall style of the carving is similar to that of a large door post found at Otakanini some five miles closer to Helensville than the present find (Archey 1933, Plate 41, Fig. 5). Archey relates the latter piece to the Hokianga bone chest styles and to the carvings from Takahue near Kaitaia (Archey 1967, p. 238). Pieces from these areas are all linked by a combination of head form, spiral and surface decoration. The areas are also linked by tribal history as the present or former dwelling places of the Ngati Whatua tribe or their close relatives. The present day

Fig. 1. The Kaipara lintel (Auck. Mus. 45048).
(Photo: Vahry)

tribe of the South Kaipara is the Ngati Whatua. Te Roroa tribe of Waimamaku, where many of the bone boxes in Auckland Museum come from, are a people whose descent is Ngati Whatua and Ngapuhi. The Takahue valley in Kaitaia is noted as having been occupied by Ngati Whatua hapu which are now sub-tribes of Aupouri. Although there are undoubtedly other traditionally related areas each with their own stylistic variations in the North, the present lintel, the other Kaipara carvings and the Takahue carvings can be characterised as being of Ngati Whatua origin.

The lintel itself is designed for a small house, probably a chief's house. It is likely that, like the Otakanini carvings, it was hidden during the Ngapuhi raids early in the 19th century.

The lintel was presented to Auckland Museum by Daniel Quigley and conserved by Mr Karel Peters of the University of Auckland Anthropology Department.

REFERENCES

ARCHEY, Gilbert

1933 Wood carving in the North Auckland area. *Rec. Auckland Inst. Mus.* 1 (4): 209-218.

1967 Maori Wood Sculpture: the human head and face. *Rec. Auckland Inst. Mus.* 6 (3): 229-230.

A CARVING FROM KAIKOHE

D. R. SIMMONS
AUCKLAND INSTITUTE AND MUSEUM

For cultural reasons, this image has been removed.

Please contact Auckland Museum for more information.

Fig. 1. Carving from Kaikohe (Auck. Mus. 45506). (Photo: Vahry)

In 1972 Mr Roger Henwood found a carved slab of wood in a stream bed on his farm six miles (9.6 km) south of Kaikohe in a position marked by grid reference 336928 on map N15 NZMS1, Kaikohe. The carving has been worn by being in the water and had obviously been hidden in a slightly swampy area just upstream of where it was found.

The piece (Fig. 1) is a plank 164 cm long, 18 cm wide at the centre, 2.3 cm thick and the carved area raised 6.5 cm from this. It has a chamfered basal section 12.5 cm wide for insertion into a slot or the ground. Holes for lashings are at the centre top, right-hand top and right-hand centre. The carving, executed with stone tools, consists of a serpentine figure with eel-like body, forming a crescent raised in the centre. The head is pointed with long oblique eyes and a mouth much wider than the rest of the head. On the left side, an arm ending in manaia is raised to the chin; on the right, the hand, probably with a manaia terminal, is curved downward to the centre line. Below, the remains of a leg with a manaia terminal appear on the right. Decorations on the arms, where they can be seen, consist of three grouped crescents between lines. This type of decoration is also present in the lower area of the abdomen.

The centre of the figure has a square hole through which the bar to hold a solid doorway in place could be inserted. This contrasts with the Ngati Whatua type of storehouse door jamb where the bar holes are pierced through the male/female area of the carving with the body curved to the outside of the plank. A similar door jamb from Peria in Mangonui (Auck. Mus. 37397) has the same inward curving crescent with bar hole in the centre as in this piece, except that the raised crescent shape is undecorated and apparently was never intended to be decorated.

The stream in which the carving was found is about a quarter-mile from a fine old pa now used as a burial ground (*urupa*) and it seemed possible that the carving was associated with this site. Subsequent information has, however, established a more probable history.

It seems that the piece found is one of the carvings for the storehouse called "Te Ipu Hakena" which last stood about a mile (1.6 km) south at Mangatapere village (N15 346255). It was made by the well-known carver of the Ngapuhi, Kohuru Te Whata, who lived eight generations ago and belonged to the Ngai Tu tribe of Te Auru. Kohuru was commissioned by the eldest son of Rawheo of the Ngati Rawheo to carve a storehouse. One of Rawheo's people assisted him. When the house was finished, difficulties arising from the offered and expected gifts given to Kohuru Te Whata, resulted in the home tribe taking offence. As a result the house was pulled down and the pieces hidden. The piece carved by Kohuru Te Whata is said to have been hidden very close to the locality where the carving was found.

According to Ngapuhi tradition as told by the people of Tautoro, Kaikohe and Hokianga, Kohuru is credited with having carved food stores and burial chests and is normally placed on the genealogies as:

Rahiri
Kaharau
Taurapoho
Tupoto
Tuteauru
Kohuru Te Whata

eight generations from people now living. This line would suggest that Kohuru lived about two hundred years ago.

Mr Henwood generously presented the carving to Auckland Museum when the ethnologist went to inspect the find and its locality. It was then treated by Mr Karel Peters of the University of Auckland Anthropology Department and is now in a perfect state of preservation.

NOTES ON THE CHEESEMAN HERBARIUM

Part 1. Exchange with U.S.A. herbaria before 1900

JEANNE H. GOULDING
AUCKLAND INSTITUTE AND MUSEUM

Abstract. Exchanges between Isaac C. Martindale, William M. Canby and other American collectors, with T. F. Cheeseman, are traced through specimens in the Auckland Institute and Museum Herbarium (AK) and letters to Cheeseman in the manuscript collection of the Auckland Institute and Museum Library.

In a recent paper, Meyer & Elsasser (1973) recorded that more than 200 Cheeseman specimens were in the Martindale Herbarium now at United States National Aboretum Herbarium, Washington, D.C. This information initiated a check of Martindale material in the Cheeseman Herbarium, Auckland Institute and Museum, and a perusal of letters to Cheeseman from botanists. Subsequent correspondence with Dr Meyer about the Martindale specimens in Auckland brought the reply, "It never occurred to us that you might have this material, since we are missing most of the Martindale correspondence." It is hoped that the following notes may bring to the notice of botanists the presence, in Auckland Institute and Museum Herbarium, of pre-1900 duplicate specimens from U.S.A. collections, and also point out the whereabouts of many early Cheeseman specimens sent in exchange.

History of exchange

The exchange of botanical specimens between the Auckland Institute and Museum and overseas herbaria was begun by Mr T. F. Cheeseman in 1877. According to the *Report of the Auckland Institute for 1877-78*, arrangements were made by the Curator (Mr Cheeseman) "for interchanges with most of the principal European Museums, and a considerable number of specimens in all branches of natural history have been specially collected for this purpose." As well as writing to European museums, Cheeseman, in 1877, sent requests for exchange to eminent botanists at major institutions in U.S.A. which led to large-scale exchange with the two private American herbaria of Isaac C. Martindale, of Camden, New Jersey, and William M. Canby, of Wilmington, Delaware.

Isaac C. Martindale (1842-1893)

"The 19th century herbarium of Isaac C. Martindale" (Meyer & Elsasser, 1973) contains an account of Martindale's life, the history of his herbarium and biographical notes on some of the many collectors who contributed to the herbarium. Therein it is stated that Isaac C. Martindale, a Quaker, was cashier in the National State Bank, Camden, New Jersey, and for some years "was Treasurer of the Academy of Natural Sciences of Philadelphia and a corresponding secretary of its botanical section". In the 1880s his was the second largest private herbarium in U.S.A., equal in quality to any of the institutional herbaria. After Martindale's death his herbarium

C52 No. 1209.

JOHN GILL, *President*, ISRAEL W. HEULINGS, *Vice-President*.
ISAAC C. MARTINDALE, *Cashier*,

National State Bank,

Camden, N. J. Oct. 15th 1877

T. F. Cheeseman,

My friend Prof. J. Rothrock of the University of Penna. Philada has placed in my hands the correspondence from you relative to an exchange of plants, and has asked me to make the exchange as he had arranged for. He has very unexpectedly accepted a position in a scientific Expedition just fitting out to go around the world, I have not their programme before me, but it is possible New Zealand may be one of their stopping places, at any rate it purports to be a two years cruise, It gives me pleasure to make this exchange, for whilst my collection is well supplied with North American plants, Your district is scarcely represented, Your list states an exchange of 500 species, I presume with your permission, changing that somewhat, and will make up a package for you of all the species, of which I have duplicates, which

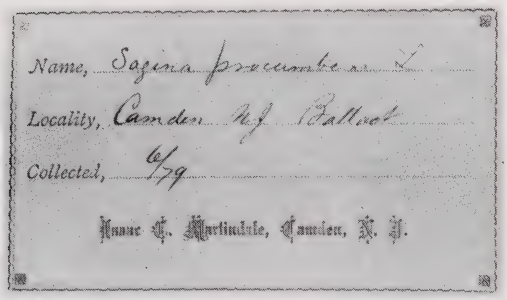
Fig. 1. Portion of letter from Isaac C. Martindale to T. F. Cheeseman, 15 October 1877.

was bought, in 1894, by an old pharmaceutical firm for the Philadelphia College of Pharmacy and Science where it stayed until 1964, when the Martindale Herbarium of about 80,000 specimens was purchased by the United States Department of Agriculture for the National Arboretum, Washington, D.C. The principal collections are from North America and Europe but New Zealand is surprisingly well represented by "a fine set of T. F. Cheeseman along with a few collections of Thomas Kirk and Donald Petrie." Cheeseman's "fine set" amounts to at least 1800 specimens, according to Martindale correspondence in the manuscript collection in the Auckland Institute and Museum Library. Reciprocally, the Cheeseman Herbarium received a "fine set" of some 1800 specimens from Martindale.

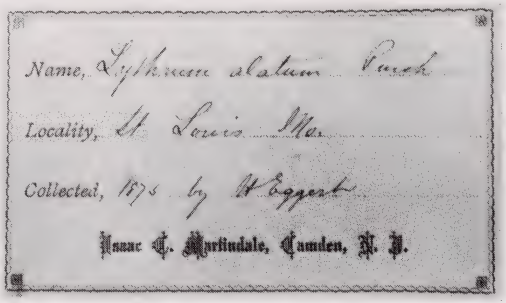
Exchange with Martindale was initiated by Cheeseman when he sought to exchange 500 specimens with H. C. Ward, Professor of Botany, University of Pennsylvania, Philadelphia, in May 1877. Professor Ward passed on this request to his successor, Professor J. T. Rothrock, who agreed to start an exchange with Cheeseman (Rothrock to Cheeseman, 18 June 1877). However, Rothrock "very unexpectedly accepted a position in a scientific Expedition just fitting out, to go around the world . . . "(Martindale to Cheeseman, 15 October 1877) (Fig. 1) and in turn passed the request to his friend Isaac C. Martindale. When the latter wrote to Cheeseman in October 1877 he proposed a larger exchange "nearer 1000 species". By November 1879 he claimed to have forwarded 1325 species to Auckland and he sent a further 475 in January 1881.

Cheeseman was indeed fortunate to receive so much ex Martindale material. According to Meyer & Elsasser (1973) Martindale "preferred to collect in fairly small sets, and for this reason his duplicates are not well represented in the herbaria of this country [U.S.A.]." It is known that Martindale sent duplicates "to Berlin and perhaps elsewhere on the Continent" but no specimens were listed at Kew or at Edinburgh. "Two specimens from New Jersey" were recorded at Oxford Herbarium (Clokie 1964).

The large number of duplicates of Martindale's personal collecting of ballast plants and weeds in his own state of New Jersey (Fig. 2) has proved most useful as reference material in identifying adventives of the Auckland province. Also included in the ex Martindale Herbarium material now in the Auckland Institute and Museum are specimens from other American collectors of the 19th century: G. Anspach,



2



3

Figs. 2, 3. Herbarium labels. 2. Martindale label, June 1879 (11cm x 6.5cm). 3. Martindale label — collector H. Eggert, 1875 (11cm x 6.5cm).

C. F. Austin, J. W. Congdon, J. M. Coulter, H. K. D. Eggert (Fig. 3), E. Hall, T. Meehan, C. T. Mohr, E. Palmer, C. F. Parker, C. C. Parry, T. C. Porter, C. G. Pringle, W. W. Smith and L. F. Ward. As well as the hundreds of Cheeseman specimens in the Martindale Herbarium, to be seen today in the National Arboretum Herbarium, Washington, D.C., are New Zealand plants collected by J. F. Armstrong, T. Kirk, D. Petrie and W. Swainson, all ex Cheeseman Herbarium.

The shipping of exchange material between Auckland and U.S.A. was handled by Hugh Craig, Agent for Pacific Coast, in the California branch of the New Zealand Insurance Company, San Francisco. From Martindale's letters to Cheeseman it appears that the express freight from Camden, New Jersey, to San Francisco (US$8.75) was more than twice the freight and dock charges from San Francisco to Auckland (US$3.75). Mr Martindale made it clear that they should both share the "whole expense, whatever that may be, and when our whole exchange is completed we must have a settling day". (Martindale to Cheeseman 26 March 1878).

William M. Canby (1831-1904)

At much the same time and in much the same way Cheeseman began exchanging botanical specimens with William M. Canby of Wilmington, Delaware, whose private collection is now in the herbarium of the New York Botanical Garden (Meyer and Elsasser, 1973). In this instance Cheeseman first sought exchange (7 March 1879) with the celebrated botanist Asa Gray at Harvard University. Gray, who was fully occupied (revising his Manual of Botany?) sent Cheeseman's request to Canby, who agreed to supply the 700 species asked for, at once, and if further exchange was desired "could probably furnish specimens of several thousand species". (Canby to Cheeseman 8 April 1879). When Cheeseman sent his first package of plants to Canby he included a parcel for Asa Gray, who wrote in acknowledgement, "The specimens are most welcome. I was well supplied with the *old* New Zealand plants, but had almost none of these from the South and the interior. To show my gratitude and at the same time to save both of us trouble I am sending to Mr Canby a good many rare plants — as they come into my reach — to eke out the parcels he will send you." (Gray to Cheeseman 2 October 1879).

Canby was a friend of Martindale and both collectors, in their correspondence with Cheeseman, say how pleased they knew the other to be with the plants from New Zealand. Upon receipt of the first package Canby wrote to Cheeseman (30 September 1879), that he was delighted with the contents:

> "In fact I do not remember to have ever received an envoi of plants which gave me more genuine pleasure and satisfaction. The specimens are remarkably fine and well taken; and the evident care that has been bestowed upon them in order that they might show well the characters of each species is something that in my experience is lamentably rare . . . At the same time that I received your package came one from Syria and the contrast between your specimens and those of my Syrian correspondent were very striking. Something is due I suppose to the difference in character of the floras of the two countries. The Syrian plants have a rough *weedy* appearance very different from the clean bright *native* cut of the New Zealand ones.
>
> Having but slight knowledge of your flora I was very much struck with the alliance to and yet difference from our own. It astonished me to find so many orders and even genera the same as are represented in this country, and yet the specific types seemed far apart. I believe that there were but two plants, viz. Oxalis corniculata and Triglochin triandrum Mx. which were identical with our species. (It was truly surprising to me to find the latter in the collection.) . . . "

In May 1882, Canby also wrote:

> "I have been very much charmed with the specimens you have sent me which do much to complete a representation of the very interesting flora of New Zealand. I have been very much interested in collating the specimens with some of Baron Mueller's [Ferdinand von Mueller, Government Botanist, Melbourne] but find more differences than similarities. I beg to thank you very sincerely for the great pleasure you have given me by means of this parcel . . . The rare and in many cases singular plants of the mountains of the South Island have given me peculiar pleasure."

As exchange, Canby in 1880, sent one box of "some 1800 species". He wrote, "The bulk of the collection is made up of plants from the Eastern or Atlantic slope of the continent, including some of Dr Garber's and Mr Curtiss' rare Florida collections." Canby's own collections were from Eastern United States and many from his own state of Delaware (Fig. 4). Cheeseman apparently asked for some *Carex* species which Canby tried to obtain from other botanists without success so obligingly sent some from his own herbarium sheets (Fig. 5). Canby had "exchanged with everyone he could find who made good specimens" and "purchased all the collections of Curtiss, Hall, Bolander, Kellogg and other California and Oregon botanists." (Harshberger, 1899).

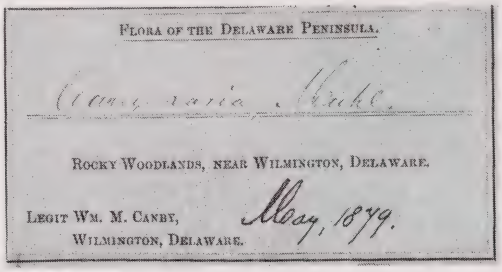


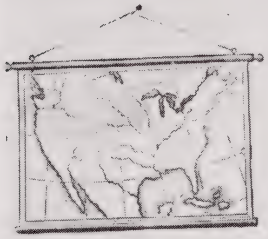
Fig. 4. Canby label — Flora of the Delaware Peninsula, May 1879 (9cm x 4.6cm).

Some well known collectors whose specimens are in the ex Canby material in the Auckland Institute and Museum Herbarium are: M. S. Bebb (a specimen of *Carex bebbii)*, J. Blake, Dr Blodgett, H. N. Bolander, W. Boott, Mrs A. E. Bush, G. Butler, A. Commons, A. H. Curtiss, A. P. Garber, A. Gattinger, H. Gillman, M. E. Hyams, J. H. Mellichamp, E. Palmer (Fig. 6), C. C. Parry, H. N. Patterson, T. C. Porter, C. G. Pringle, Miss M. J. Reynolds and J. T. Rothrock (Fig. 7).

Thomas Morong (1827-1894)

Requests for specimens were received by Cheeseman from other American botanists after they had heard of Martindale's and Canby's exchanges or had read papers by Cheeseman in the *Transactions and Proceedings of the New Zealand Institute.*

The Reverend Thomas Morong, who described several American species of *Potamogeton,* wrote from Massachusetts (Morong to Cheeseman, 24 October 1887) asking for an exchange of aquatic plants, "having learned more or less of your collections from my friends, Mr Arthur Bennett of Croydon, England, and Mr W. M. Canby, of Wilmington, Del., in this country. Indeed Mr Bennett has sent me several



Northern Transcontinental Survey

DEPARTMENT OF ECONOMIC BOTANY
Wm. M. Canby, in charge.

Wilmington, Del. July 14 188

My Dear Sir,

I have done my my best to obtain for you the specimens you desire by corresponding with our botanists but have been entirely unable to get specimens. If I can do so hereafter I will send promptly.

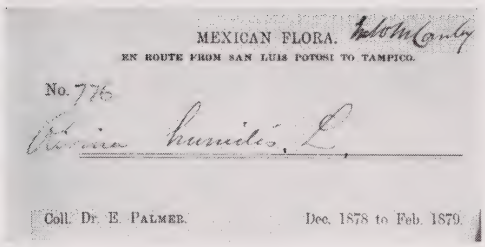
At present I can only say that I have (C. capitata) and what I once knew for my Herbarium thus (C. Sprengelii). I can hardly hope that they will be of service.

I have very much enjoyed looking over the last specimens you sent which I value very much.

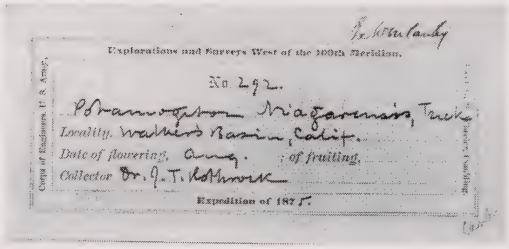
Very Sincerely Yours

Wm. M. Canby

Fig. 5. Letter from Wm. M. Canby to T. F. Cheeseman, 14 July 1882.



6


Explorations and Surveys West of the 100th Meridian.
No. 292.
Locality, Walker's Basin, Calif.
Date of flowering, Aug. ; of fruiting,
Collector Dr. J. T. Rothrock
Expedition of 187 5.

7

Figs. 6, 7. Herbarium labels. 6. Label of Dr E. Palmer, 1878-1879, ex Canby Herbarium (10cm x 4.6cm). 7. Label of Dr J. T. Rothrock, 1875, ex Canby Herbarium (11.5cm x 4.5cm).

Potamogetones of your collection, one of which he has named for you 'P. Cheesemanii'." There is no further correspondence to confirm that any exchange took place between Cheeseman and Morong. The aquatic plants collected by Morong, in the Cheeseman Herbarium, are mostly labelled ex A. Bennett Herbarium. Bennett sent specimens from many collectors from many countries and it would be interesting to know how much Cheeseman material, sent to him in exchange, was re-distributed throughout the world.

Liberty Hyde Bailey (1858-1954)

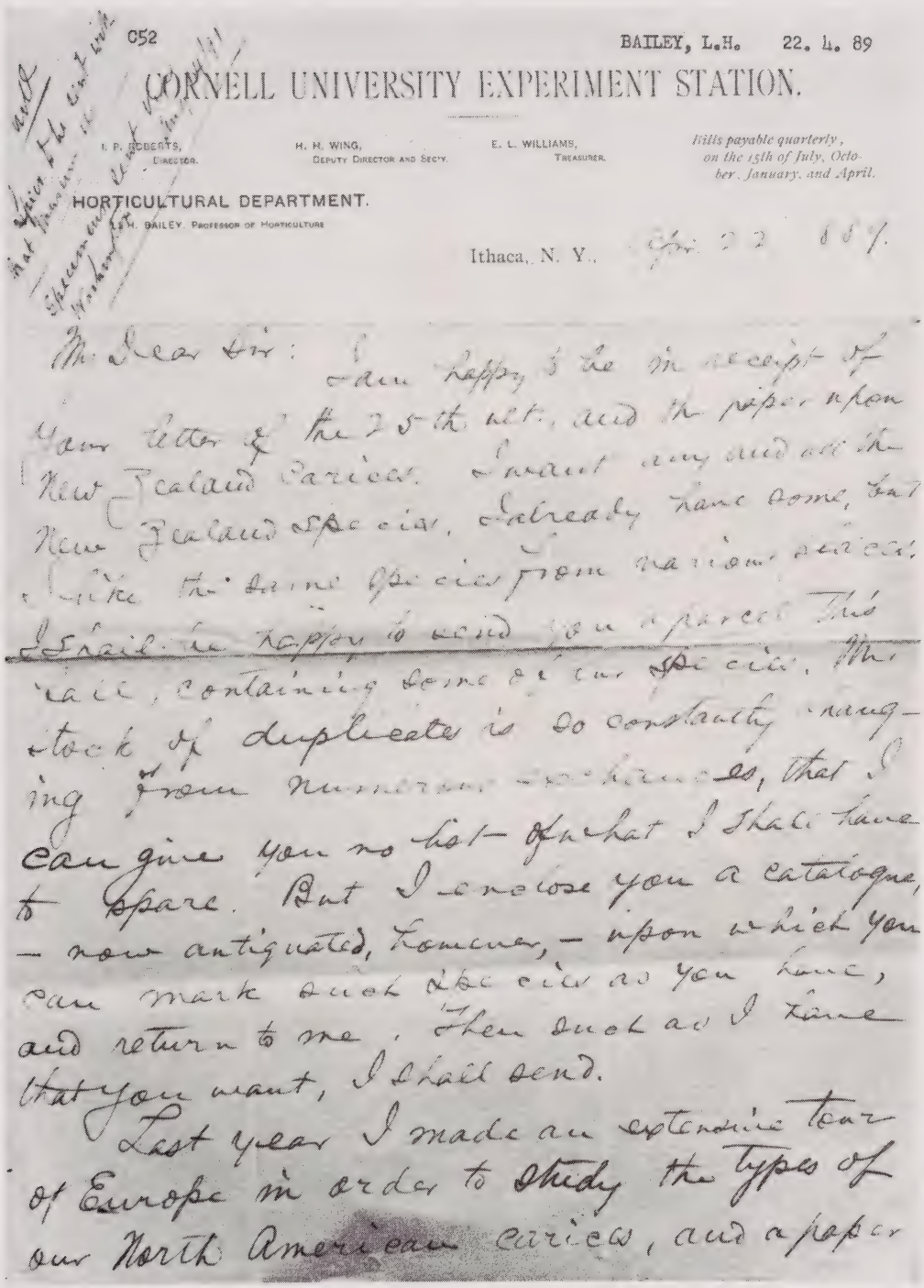
Liberty Hyde Bailey (author of *The Standard Cyclopedia of Horticulture*) wrote from Cornell University asking Cheeseman for New Zealand Carices and was sent a package of these in 1891 (Fig. 8). Later, in 1916, Bailey wrote:

> "One never knows what is to be found in an attic. I am now gradually mounting up all my specimens and I found a package in my attic of cyperaceous plants other than Carices which contained a very interesting lot of material. There were plants from Sardinia, Siberia, Spicer's things from Tasmania, and a lot of very interesting things collected by you between the years 1875 and 1881. How this package ever came into my possession, I do not know, but it was one of the exchanges that many years ago came into my hands among other good things. I was specially glad to see these good specimens from you and I have laid them all out to be mounted. Of course I have the very valuable collection of Carices that you sent me many years ago, but these plants I really did not know I had."

The exchange with Bailey seems to have been in his favour as none of his collections have been found in the Cheeseman Herbarium, although many American *Carex* species, described by him in early volumes of *Memoirs Torrey Botanical Club,* were sent by other collectors. *Carex* specimens ex Canby are plentiful but are absent in Martindale material sent to Cheeseman. Martindale wrote, "I have a large collection of Carices but not having studied them especially I cannot vouch for their accuracy, as they are bothersome to the last degree . . ." (Martindale to Cheeseman, 11 May 1882).

Herman Theodor Holm (1854-1932)

Another enquiry about Carices came from Theo. Holm, U.S. Department of Agriculture, Washington, D.C., who first wrote to Cheeseman in 1892. A parcel of *Carex* specimens was sent to Holm in 1893 and Cheeseman requested Californian and Arctic species in return, which he received. Later, in 1896, Holm wrote that he had mailed European Carices (Fig. 9) but these do not appear in the Cheeseman



C52 BAILEY, L.H. 22. 4. 89

CORNELL UNIVERSITY EXPERIMENT STATION.

I. P. ROBERTS, DIRECTOR. H. H. WING, DEPUTY DIRECTOR AND SEC'Y. E. L. WILLIAMS, TREASURER.

Bills payable quarterly, on the 15th of July, October, January, and April.

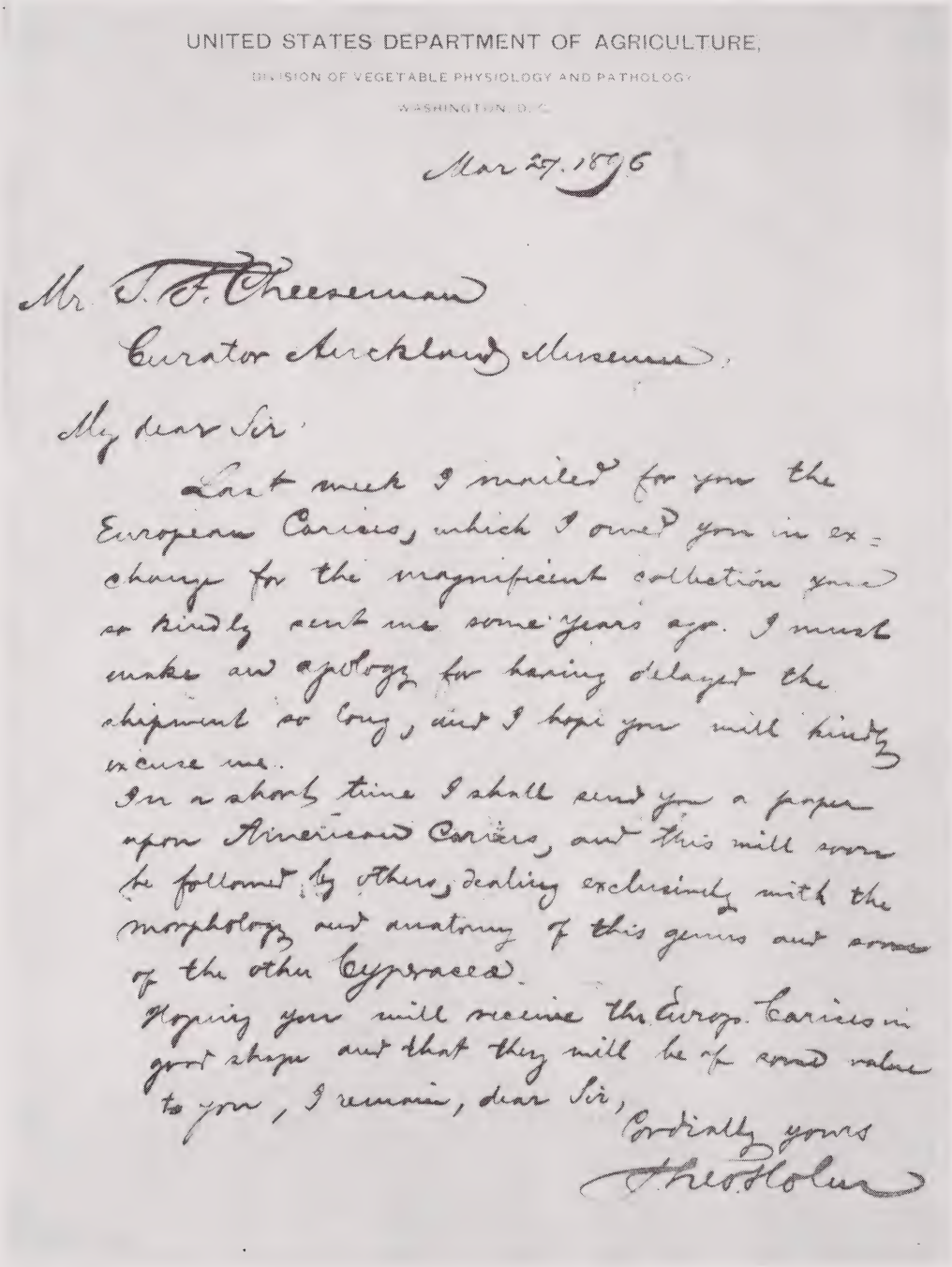
HORTICULTURAL DEPARTMENT.

L. H. BAILEY, PROFESSOR OF HORTICULTURE

Ithaca, N. Y., Apr 22 1889.

My dear Sir: I am happy to be in receipt of your letter of the 20th inst., and the paper upon New Zealand Carices. I want any and all the New Zealand species, already have some, but like the same species from various areas. I shall be happy to send you a parcel. This sale, containing some of our species. My stock of duplicates is so constantly changing from numerous exchanges, that I can give you no list of what I shall have to spare. But I enclose you a catalogue, — now antiquated, however, — upon which you can mark such species as you have, and return to me, when such as I have that you want, I shall send.

Last year I made an extensive tour of Europe in order to study the types of our North American carices, and a paper



UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY
WASHINGTON, D. C.

Mar 27. 1896

Mr. T. F. Cheeseman
Curator Auckland Museum.

My dear Sir:

Last week I mailed for you the European Carices, which I owed you in exchange for the magnificent collection you so kindly sent me some years ago. I must make an apology for having delayed the shipment so long, and I hope you will kindly excuse me.

In a short time I shall send you a paper upon American Carices, and this will soon be followed by others, dealing exclusively with the morphology and anatomy of this genus and some of the other Cyperaceæ.

Hoping you will receive the Europ. Carices in good shape and that they will be of some value to you, I remain, dear Sir,

Cordially yours
Theo. Holm

Fig. 9. Letter from Theo. Holm, 25 May 1896.

Herbarium as ex Holm material. They may have been sent under the names of the European collectors without the Holm label. American Cyperaceae ex Holm are numerous in the Cheeseman Herbarium, especially in *Carex* with about 80 sheets (Fig. 10).

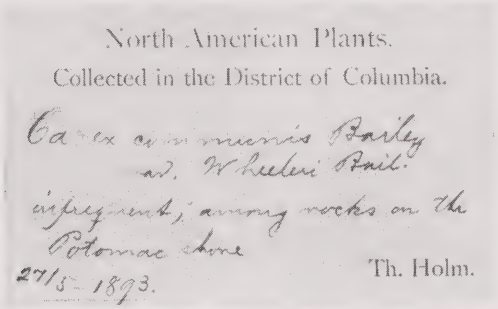

North American Plants.
Collected in the District of Columbia.
Carex cyperoides Bailey
var. Wheeleri Bail.
in fragments, among rocks on the
Potomac shore
27/5 1893. Th. Holm.

Fig. 10. Holm label, 27 May 1893 (9.5cm x 6cm).

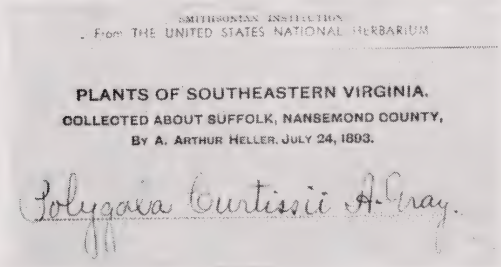
Holm's exchange included collections from: C. F. Baker, W. H. Brewer, C. I. Crandall, Walter H. Evans, Joseph V. Haberer, L. F. Henderson, T. Kearney, T. Kincaid, P. A. Rydberg, W. Trelease, T. A. Walpole.

U.S. National Museum, Smithsonian Institute

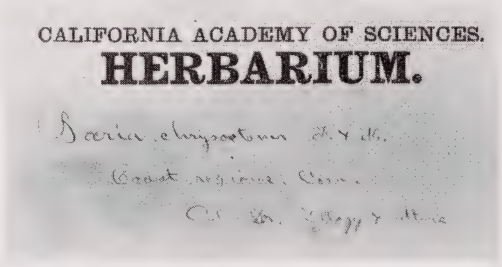
In 1891 Cheeseman sent natural history specimens, as exchange, to the U.S. National Museum, Smithsonian Institute, Washington D.C., including "470 species of New Zealand plants". He wrote to Professor Brown Goode, Smithsonian Institute, "The plants have been almost wholly collected by myself, during various exploring journies in both Islands of New Zealand. You can rely on the nomenclature and localities." (Cheeseman to Brown Goode 14 August 1891). Not many collections of this pre-1900 period, from the United States National Herbarium, labelled as such, have been located in the Cheeseman Herbarium (Fig. 11).

California Academy of Sciences

A few of the old California Academy of Sciences labels, with HERBARIUM printed in large bold type, are found in the Cheeseman Herbarium with collections made by Dr Kellogg (Fig. 12). Although no correspondence with him or the Academy

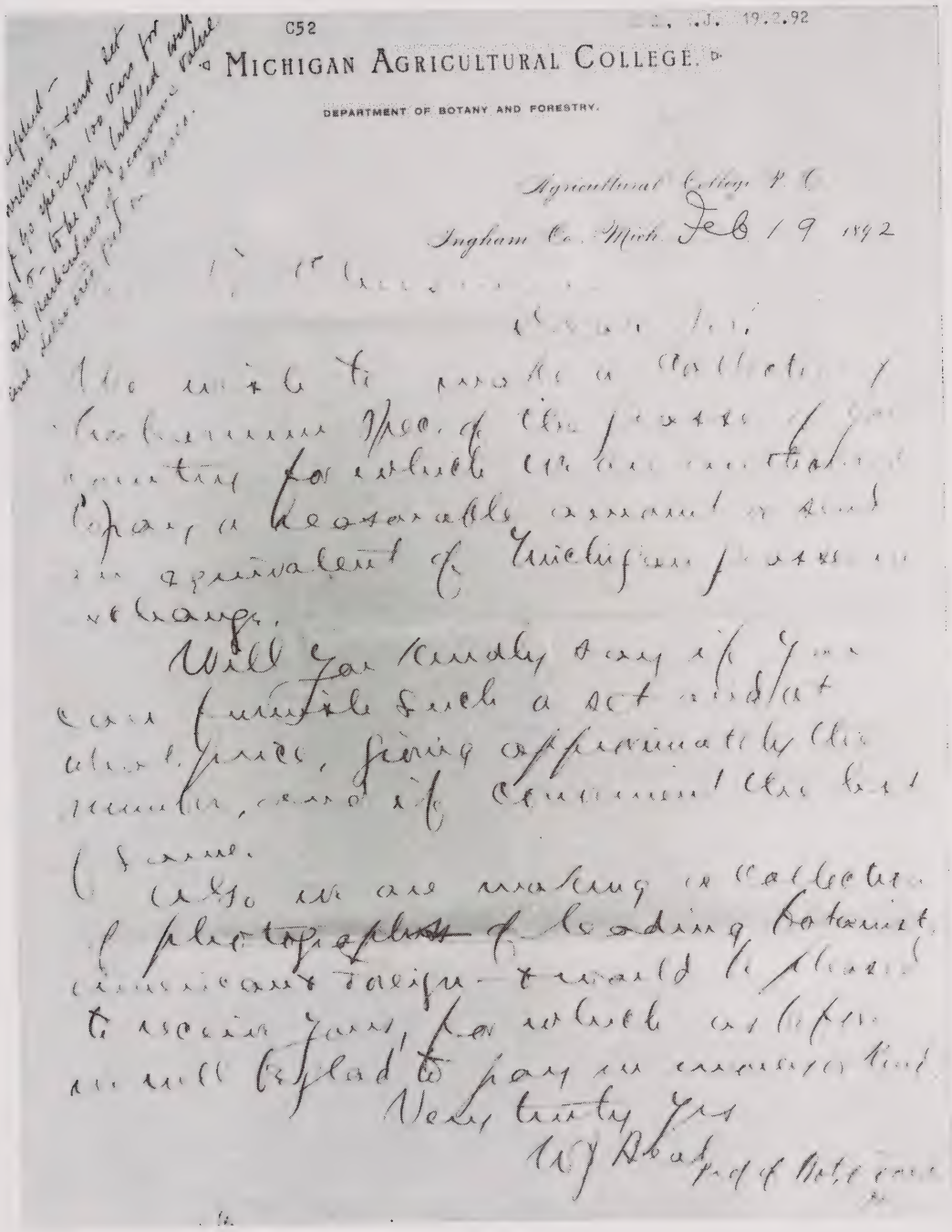

SMITHSONIAN INSTITUTION
From THE UNITED STATES NATIONAL HERBARIUM
PLANTS OF SOUTHEASTERN VIRGINIA.
COLLECTED ABOUT SUFFOLK, NANSEMOND COUNTY,
BY A. ARTHUR HELLER. JULY 24, 1893.
Polygala Curtissii A. Gray.

11


CALIFORNIA ACADEMY OF SCIENCES.
HERBARIUM.

12

Figs. 11, 12. Herbarium labels. 11. Label ex U.S. National Herbarium (9.5cm x 1.2cm) — collector A. A. Heller, 24 July 1893 (8.8cm x 4.8cm). 12. California Academy of Sciences Herbarium label — collector Dr Kellogg & others (15.2cm x 9.2cm).


C52

MICHIGAN AGRICULTURAL COLLEGE.

DEPARTMENT OF BOTANY AND FORESTRY.

Agricultural College P. O.
Ingham Co. Mich. Feb 19 1892

Fig. 13. Letter from W. J. Beal to T. F. Cheeseman, 19 February 1892.

has come to light, it is most likely that there was exchange before 1900. In 1893 Cheeseman sent seeds of New Zealand trees to Hugh Craig, the shipping agent in San Francisco, "for your 'Golden Gate' Park" (Cheeseman to Craig, 14 July 1893). Any Cheeseman specimens in the California Academy of Sciences Herbarium would almost certainly have been lost in the fire there, following the San Francisco earthquake in 1906.

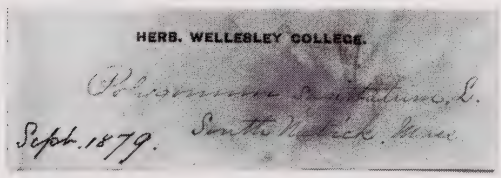
Sale of specimens

The only evidence of the sale of New Zealand botanical specimens by Cheeseman to U.S. botanists, before the turn of the century, came in letters from W. J. Beal, Department of Botany and Forestry, Michigan Agricultural College, 1892. He requested a set of New Zealand grasses from Cheeseman — "Will you kindly say if you can furnish such a set and at what price . . ." A note on Beal's letter (Fig. 13) in Cheeseman's hand, reads, "replied — willing to send set of 90 species 100 vars for £5 — to be fully labelled with all particulars of economic value and delivered free to Frisco." The collection was sent on October 7, 1892, and was duly received and paid for by W. F. Beal (Beal to Cheeseman, 1892).

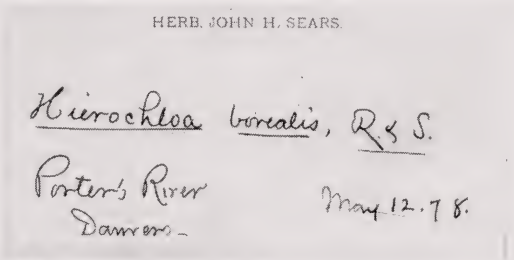
Conclusion

There are some American collections received by Cheeseman about which no correspondence has been traced — e.g. specimens labelled ex Herbarium Wellesley College (1873) (Fig. 14) and many ex Herbarium John H. Sears (1878) (Fig. 15). Fern collections of the 1870s, ex Herbarium Mrs Stiles M. Rust, include specimens from Mrs Charles Barnes and J. G. Lemmon, as well as those collected by Mrs Rust, signing herself "Mary Olivier Rust". Under the label "Herbarium Juncorum Borealis-Americanorum Normale, ed. G. Engelmann, St Louis, Missouri, 1868" there are *Juncus* specimens collected in 1866-67 by J. M. Bigelow, A. Commons, G. Engelmann, R. Hall, H. W. Ravenel and C. E. Smith. It is thought that these specimens came to Cheeseman as exchange but no letters have been found between him and the Missouri Botanical Garden.

No mention is made here of the duplicates from 19th century collectors which came to the Auckland Institute and Museum Herbarium after Cheeseman's time (1874-1923), ex Gray Herbarium of Harvard University, Missouri Botanical Garden, and the private herbarium of George R. Cooley.



14



15

Figs. 14, 15. Herbarium labels. 14. Label ex Herbarium Wellesley College (Mass.) September 1879 (10cm x 3.5cm). 15. Label ex Herbarium John H. Sears, 12 May 1878 (13.8cm x 6.6cm).

The late 19th century botanical specimens from Martindale, Canby and other American collectors, together with exchanges Cheeseman made during the same period with European herbaria, formed the nucleus of the overseas or exotic plant collections in the Auckland Institute and Museum Herbarium. Today exchange is continued with some fifteen overseas herbaria, including seven in U.S.A.

REFERENCES

CLOKIE, H. N.

1964 *An account of the herbaria of the Department of Botany in the University of Oxford*. Oxford University Press, Oxford. 280pp.

HARSHBERGER, J. W.

1899 *The botanists of Philadelphia and their work*. T. C. Davies & Sons, Philadelphia. 457 pp.

MEYER, F. G. and S. ELSASSER

1973 The 19th century herbarium of Isaac C. Martindale. *Taxon* 22 (4): 375-404.

A NOTE ON THE TYPE OF ACAENA OVINA VAR. AMBIGUA KIRK (ROSACEAE)

A. E. ORCHARD
AUCKLAND INSTITUTE AND MUSEUM

Abstract. A lectotype is chosen for *Acaena ovina* var. *ambigua* Kirk, and its identity with *A.* × *anserovina* Orchard is confirmed.

The type of *Acaena ovina* var. *ambigua* Kirk (1899) was not available for two earlier treatments of the *A. ovina* complex (Orchard 1969, 1973), in which it was suggested that Kirk's taxon was synonymous with *A.* × *anserovina* Orchard. This identity has now been confirmed.

A recent examination of material from the National Museum, Wellington, revealed that two syntypes of Kirk's variety exist, viz. J. Buchanan s.n., College Hills, Wellington, WELT 44173 (herb. Kirk), and Anon. s.n., 4.i.1894, College Paddock, WELT 44172 (herb. Kirk). Both localities are identified as the grounds of Wellington College on the side of Mt. Victoria, Wellington (B. Hamlin, pers. comm.). The type was described as "Collected by J. Buchanan, on Mount Victoria, Wellington". In view of Kirk's stated reliance on Buchanan's earlier paper (Buchanan 1871), the first of the above two specimens is the logical choice for lectotype, and has been so annotated by me. The second specimen is almost certainly a duplicate of the first (isolectotype), and has additional interest in that it is mixed on the sheet with specimens of *A. agnipila* var. *aequispina* Orchard.

The species *A.* × *anserovina* has been defined as the result of natural hybridisation between the *A. ovina* complex and the *A. anserinifolia* complex (Orchard 1973). Examination of the type of *A. ovina* var. *ambigua* confirms that this taxon is conspecific with *A.* × *anserovina*. Thus, although in many cases the exact parentage of specimens of *A.* × *anserovina* is not known, it seems likely that one parent in this case was *A. agnipila* var. *aequispina*. The other was probably *A. anserinifolia* or *A. novae-zelandiae*, but this cannot be determined now with certainty.

REFERENCES

BUCHANAN, J.
1871 On a supposed hybrid *Acaena*. *Trans. Proc. N.Z. Inst.* 3: 208.

KIRK, T.
1899 *The students flora of New Zealand.* Government Printer, Wellington.

ORCHARD, A. E.
1969 Revision of the *Acaena ovina* A. Cunn. (Rosaceae) complex in Australia. *Trans. R. Soc. S. Aust.* 93: 91-109.

1973 The *Acaena ovina* (Rosaceae) complex in New Zealand. *Rec. Auckland Inst. Mus.* 10: 97-107.

THE TAXONOMY OF SOME INDO-PACIFIC MOLLUSCA WITH DESCRIPTION OF A NEW SPECIES

PART 2

WALTER O. CERNOHORSKY
AUCKLAND INSTITUTE AND MUSEUM

Abstract. A new name is proposed for the homonymous *Cerithium pulchrum* Sowerby, and a *Cantharus (Pollia)* species from the Fiji Islands is described as new to science. The identity of *Murex dentifer* Watson, *Engina contracta* (Reeve), *E. acuminata* (Reeve), *E. gannita* Hedley, *Phos pallidus* (Powys), *P. notatus* Sowerby, *Conus excelsus* Sowerby, *C. pulcherrimus* Brazier, *C. tannaensis* (Cotton), *C. moluccensis* Küster, *C. pulcher* A. Adams and *C. proximus* Sowerby, are elucidated on the basis of their type-specimens. *Cancilla (Ziba) bantamensis* (Oostingh), a Pliocene fossil mitrid from Indonesia, is recorded living in the Nicobar Islands.

Family CERITHIIDAE

Genus **Rhinoclavis** Swainson, 1840

Rhinoclavis Swainson, 1840, Treat. Malac., p. 315. Type species by SD (Herrmannsen, 1848) *R. vertagus* =*Murex vertagus* Linnaeus, 1767.

Rhinoclavis brettinghami nom. nov. (Figs. 1, 2)

1855. *Cerithium pulchrum* "A. Adams", Sowerby, Thes. Conchyl., 2 (2): 852, pl. 177, fig. 25 (North Australia); 1961 Rippingale & McMichael, Queensl. Gt. Barrier reef shells, p. 49, pl. 4, fig. 7 (non *C. pulchrum* C. B. Adams, 1852).

1865. *Vertagus pulcher* "A. Adams", Sowerby in Reeve, Conch. Icon., 15: pl. 4, fig. 20.

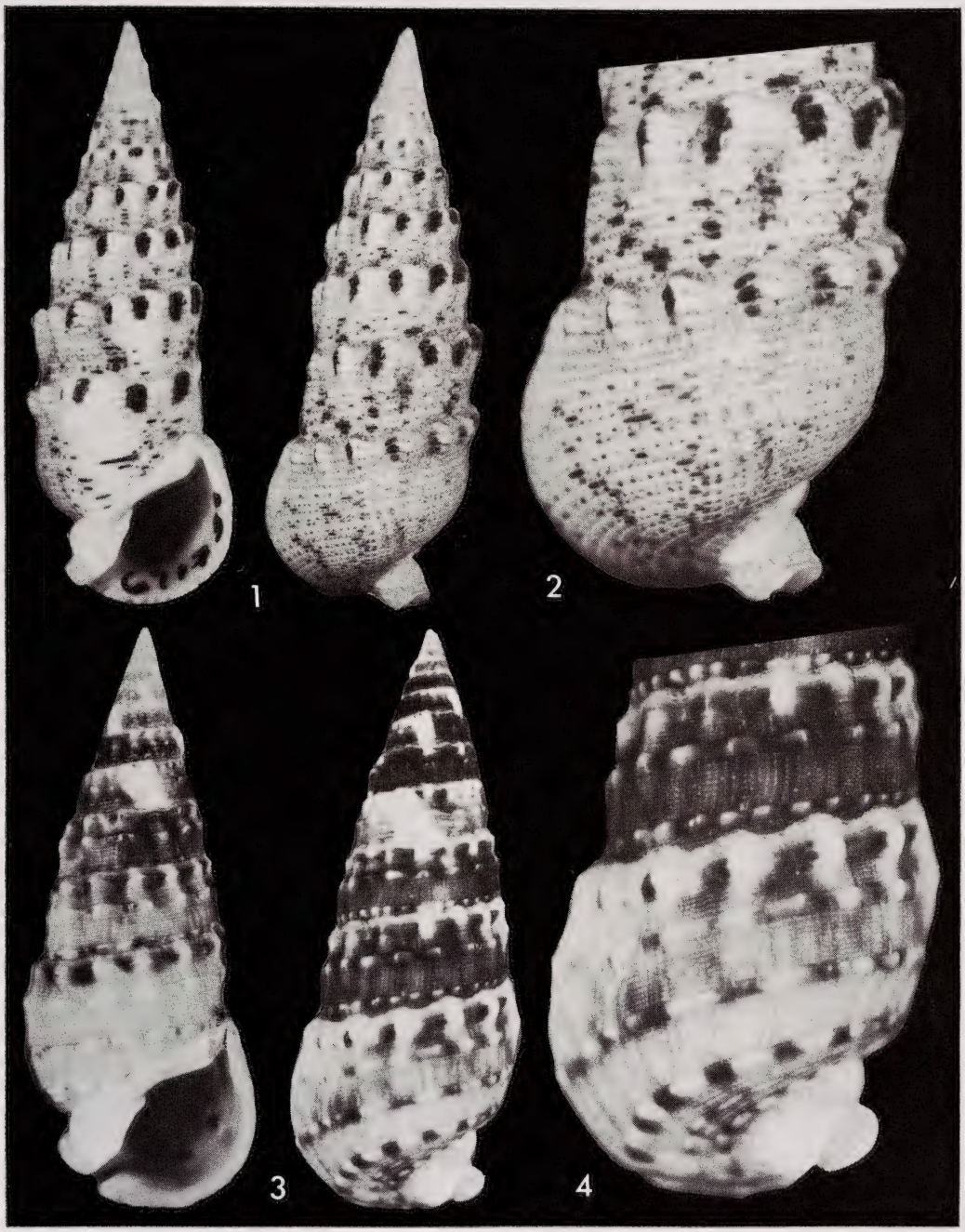
1887. *Cerithium pulcher* "A. Adams", Tryon, Man. Conch., 3: 146, pl. 27, fig. 42.

1907. *Clava pulchra* "A. Adams", Hedley, Proc. Linn. Soc. N.S.W., 32 (3): 481.

1952. *Rhinoclavis pulcher* Sowerby, Cotton, Roy. Soc. Sth. Aust. Malac. Sect., Cerithiidae, No. 2: 1, fig. 3; 1959 Allan, Australian shells, p. 89, pl. 17, fig. 18; 1963 Shikama, Sel. shells world col., 1: pl. 20, fig. 5; 1972 Cernohorsky, Mar. shells Pacific, 2: 68, pl. 15, fig. 5.

Cerithium pulchrum Sowerby, 1855, is a primary homonym of *C. pulchrum* C. B. Adams, 1852, which is a *Cerithidea* from the Eastern Pacific. The specific name is usually credited to A. Adams by early authors but the name has never been published under Adams' authorship. Bayle (1880) proposed numerous replacement names for Sowerby's *Cerithium* species, but omitted the homonymous *C. pulchrum* Sowerby, for which not even a varietal name is available.

Rhinoclavis brettinghami is endemic to Australia, ranging from West Australia to Queensland. It is superficially similar to *R. bituberculatus* (Sowerby in Reeve, 1865) [= *Cerithium semigranosum* Lamarck, 1816, non Lamarck, 1804, = *C. cordi-*



Figs. 1-4. 1, 2. *Rhinoclavis brettinghami* nom. nov. East of Cape Poivre, Barrow I., West Australia (USNM); length 41.4 mm, width 14.0 mm. 3, 4. *R. bituberculatus* (Sowerby in Reeve). Between Cape Dupuy and Cape Malouet, Barrow I., W. Australia (USNM); length 31.0 mm, width 12.3 mm.

gerum Bayle, 1880], but is coronate at the sutures and sculptured with numerous, close-set cords which are pitted in the interspaces (Figs. 1, 2). *R. bituberculatus* has two rows of larger nodules posteriorly to the sutures, and the body whorl has 3-4 nodulose spiral cords and very fine intermediate spiral threads (Figs. 3, 4). Both species are sympatric at Barrow I., West Australia and no apparent interbreeding takes place. *R. brettinghami's* range extends from West Australia to the Northern Territory and to Queensland, but *R. bituberculatus* appears to be endemic to Western Australia. The record of "Madagascar" in the National Museum of Natural History, Washington, requires confirmation.

Material examined. R. brettinghami: St. Bus I., Mackay, Qld. (USNM); Brampton I., off Mackay, Qld. (USNM); Tryon I., Capricorn group, Qld. (USNM); Hayman I., Whitsunday group, Qld. (USNM); Nth. Keppel I., Qld. (AIM); North Brook I., Qld. (AIM); Bowen, Qld. (AIM); Dingo Bay, Qld. (AIM); Yirrkala, N.W. of Cape Arnhem, Nth. Territory (USNM); S. end of Harcourt Bay, Barrow I., W.A. (USNM); E. of Cape Poivre, Barrow I., W.A. (USNM); Between Cape Dupuy and Cape Malouet, W.A. (USNM). *R. bituberculatus:* Broome, W.A. (AIM); N.E. of Gantheaume Pt., Broome, W.A. (AIM); E. of Cape Poivre, Barrow I., W.A. (USNM); Between Cape Dupuy and Cape Malouet, W.A. (USNM); Irwin River, W.A. (USNM); Dunn Bay, W.A. (USNM); Cowaramup Bay, S.W.A. (USNM); Madagascar, Indian Ocean (USNM — record requires confirmation).

Family MURICIDAE

Genus **Murex** Linnaeus, 1758

Subgenus **Haustellum** Schumacher, 1817

Haustellum Schumacher, 1817, Essai nouv. syst., p. 213. Type species by absolute tautonymy *Murex haustellum* Linnaeus, 1758.

Murex (Haustellum) dentifer Watson, 1883 (Fig. 5)

1883. *Murex (Pteronotus)* sp. *(M. dentifer* n. sp.?) Watson, J. Linn. Soc. London, 16 (96): 601 (4°34′S and 129°57′E, 200-300 fathoms = near Banda I., Moluccas, Indonesia).

1886. *Murex (Haustellum)* sp. Watson, Rept. Sci. Res. Voy. H.M.S. Challenger, 15: 153.

The description of *M. dentifer* has been based on a broken, worn and senile specimen which has the slender canal completely missing, and because of this, has never been illustrated. The holotype of *M. dentifer* in the British Museum (Nat. Hist.), No. 1887.2.9.524, measures 41.0 mm in length (minus the canal) and 31.7 mm in width; it has 3 very strong varices per whorl, 3-4 axial ribs between varices, the columella has 5 plications on the parietal wall and another 5 smaller denticles near the start of the siphonal canal, the outer lip is denticulate and the specimen has faded to greyish-white. The anal notch is only weakly indicated and not as prominently "key-hole"-shaped as in *Haustellum haustellum* (Linnaeus). *Murex dentifer* from the Moluccas is most similar to *Murex tweedianus* Macpherson, 1962, from East Australia, but the former lacks the short spines on the varices, but which admittedly could have been worn away in *M. dentifer*. Another similar species is *Haustellum wilsoni* D'Attilio & Old, 1971, from Western Austrlia, a species which also lacks the deep anal notch of *Haustellum,* but has a finer sculpture and canaliculate sutures.

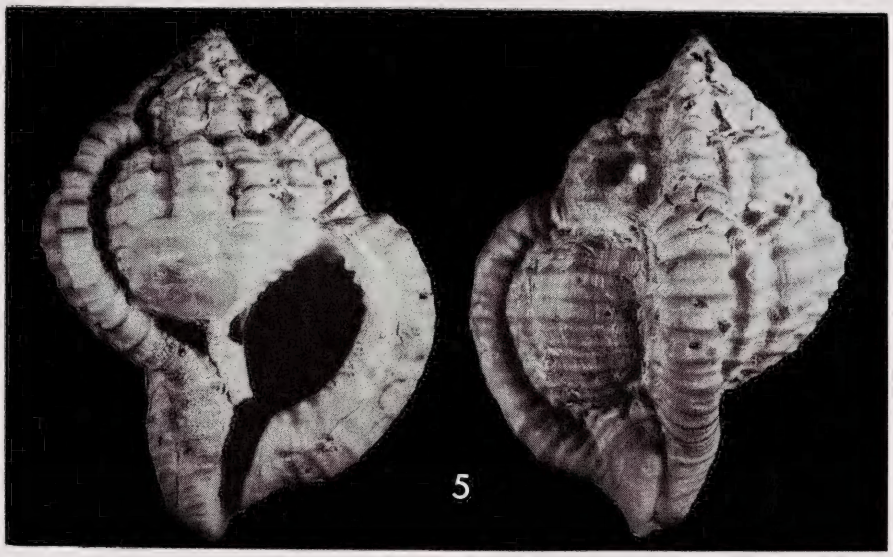


Fig. 5. *Murex (Haustellum) dentifer* Watson. Holotype B.M.N.H., 41.0 + × 31.7 mm.

Family BUCCINIDAE

Genus **Cantharus** Röding, 1798

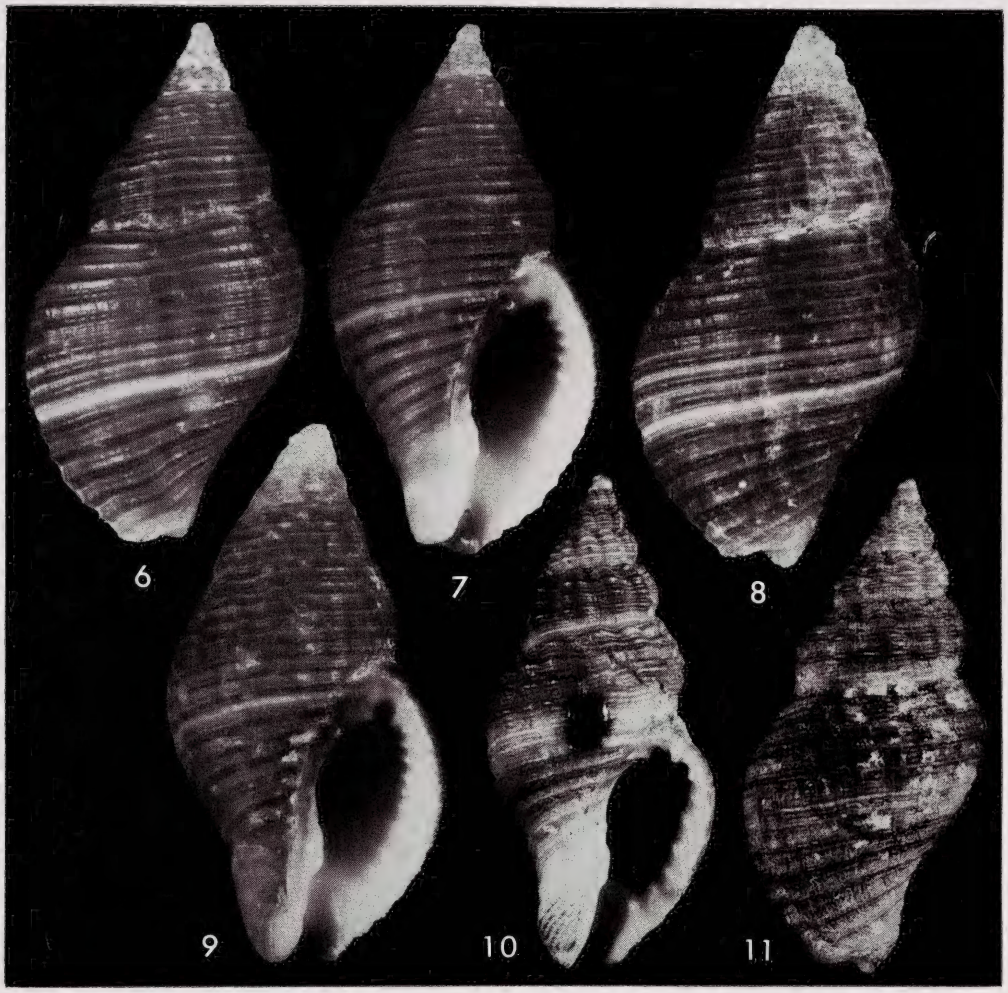
Subgenus **Pollia** Gray in Sowerby, 1834

Pollia Gray in Sowerby, 1834, Gen. Rec. Foss. shells, 2: footnote to *Purpura,* pl. 237, fig. 12. Type species by M *Triton undosum* Lamarck = *Buccinum undosum* Linnaeus, 1758.

Cantharus (Pollia) wrightae sp. n. (Figs. 6-9, 12, 13)

1971. *Cantharus (Pollia) subrubiginosus* (E. A. Smith), Cernohorsky, Rec. Auckland Inst. Mus., 8: 157, textfigs. 61, 71 (figd. holotype); 1972 Cernohorsky, Marine shells Pacific, 2: 142, pl. 38, fig. 7 (figd. holotype) [non *Tritonidea subrubiginosa* E. A. Smith, 1879].

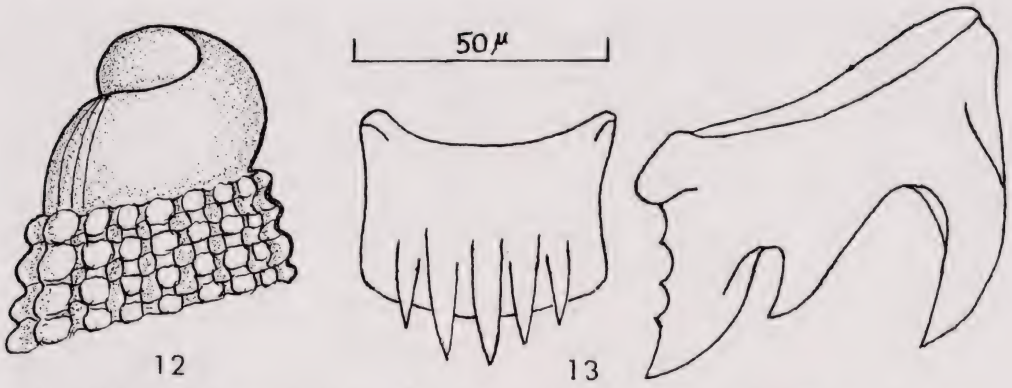
Shell small, not exceeding 17.0 mm in length, acuminate and solid, protoconch of 2 smooth, white nuclear whorls, teleoconch of 5¼-5½ regularly convex whorls, sutures weakly impressed. First 3 postnuclear whorls sculptured with axial ribs and overriding spiral cords, axial sculpture vanishing on the last 2 whorls; spiral sculpture consisting of narrow, slightly elevated spiral cords which number from 7-8 in adults and from 4-5 in juveniles on penultimate whorl, and from 21-23 in adults and 18-20 in juveniles on the body whorl. The interspaces are broader than the cords, and contain 1-2 very fine spiral threads which are sectioned into laterally oriented fillets by very fine axial hairlines. Aperture longer than the spire, moderately open, outer lip with 11-12 denticles which continue as lirae into the aperture, parietal wall with a white callus and a denticle, centre of columella only glazed and with 4-5 cords visible under the glaze, anterior of columella calloused and protruding and with 2 moderately large denticles, a third denticle being set slightly posteriorly. Siphonal canal short, siphonal notch prominent. Uniformly dark reddish-brown in colour, ornamented with only a single white band which occupies the space between 2 cords, aperture bluish-white.



Figs. 6-11. 6-9. *Cantharus (Pollia) wrightae* sp. n. Nananu-i-Ra I., Fiji Is. 6, 7. Holotype AIM, No. TM-1342; length 15.8 mm. 8, 9. Paratype, length 16.2 mm. 10, 11. *C. (P.) subrubiginosus* (E. A. Smith). Holotype B.M.N.H. No. 1878. 11.11.18; length 17.3 mm, width 8.4 mm.

Radula typically buccinoid, formula 1-1-1, rachidian teeth concave at base and with 5 slender cusps which decrease in size towards the sides, laterals of the *Pollia* pattern, tri-cuspid, with the inward-facing cutting edge of the first cusp dentate (Fig. 13).

TYPE LOCALITY. Nananu-i-Ra I., off the North coast of Viti Levu, Fiji Islands.
RANGE. On various coral reef islands off the coast of Viti Levu, Fiji Islands. Habitat: On reefs, among coarse weed on the underside of coral rocks, intertidal.
Holotype. In Auckland Institute and Museum, No. TM-1342; length 15.8 mm, width 8.1 mm, height of aperture 9.3 mm (Figs. 6, 7).



Figs 12, 13. *Cantharus (Pollia) wrightae* sp. n. 12. Protoconch. 13. Radula — half of one transverse row.

Paratypes. 5 paratypes in collection E. Wright, Sanibel I., Florida.

C. (P.) wrightae was originally presumed to have been conspecific with *Tritonidea subrubiginosa* E. A. Smith, from Japan, but examination of the type specimens of *T. subrubiginosa* in the British Museum (Nat. Hist.) No. 1878.11.11.18, has shown that the 2 species are not conspecific. *T. subrubiginosa,* although about the same size as *Cantharus (Pollia) wrightae,* is more slender, the sutures are more distinct, whorls considerably more convex with a coarser sculpture which is slightly rougher, the spiral cords are undulate, the axial ribs are prominent to the penultimate whorl which has 6 spiral cords, and the outer lip has only 6-7 denticles. In colouring, both species are quite different (Figs. 10, 11).

C. (P.) wrightae approaches *C. (P.) fumosus* (Dillwyn, 1817) in shape, but the latter species is considerably larger, has crude axial ribs, a different spiral sculpture and colouring, and the aperture is edged with yellow or orange. Both species are sympatric in the Fiji Islands, but *C. (P.) fumosus* is never found in the same habitat as *C. (P.) wrightae* and no intergrades occur.

The species is named for Miss Eugenia Wright, Sanibel Island, Florida, in whose collection the specimens were deposited.

Genus **Engina** Gray, 1839

Engina Gray, 1839, Zool. Capt. Beechey's Voy. Blossom, p. 112. Type species by SD (Gray, 1847) *E. zonata* Gray, 1839 = *Purpura turbinella* Kiener, 1836.

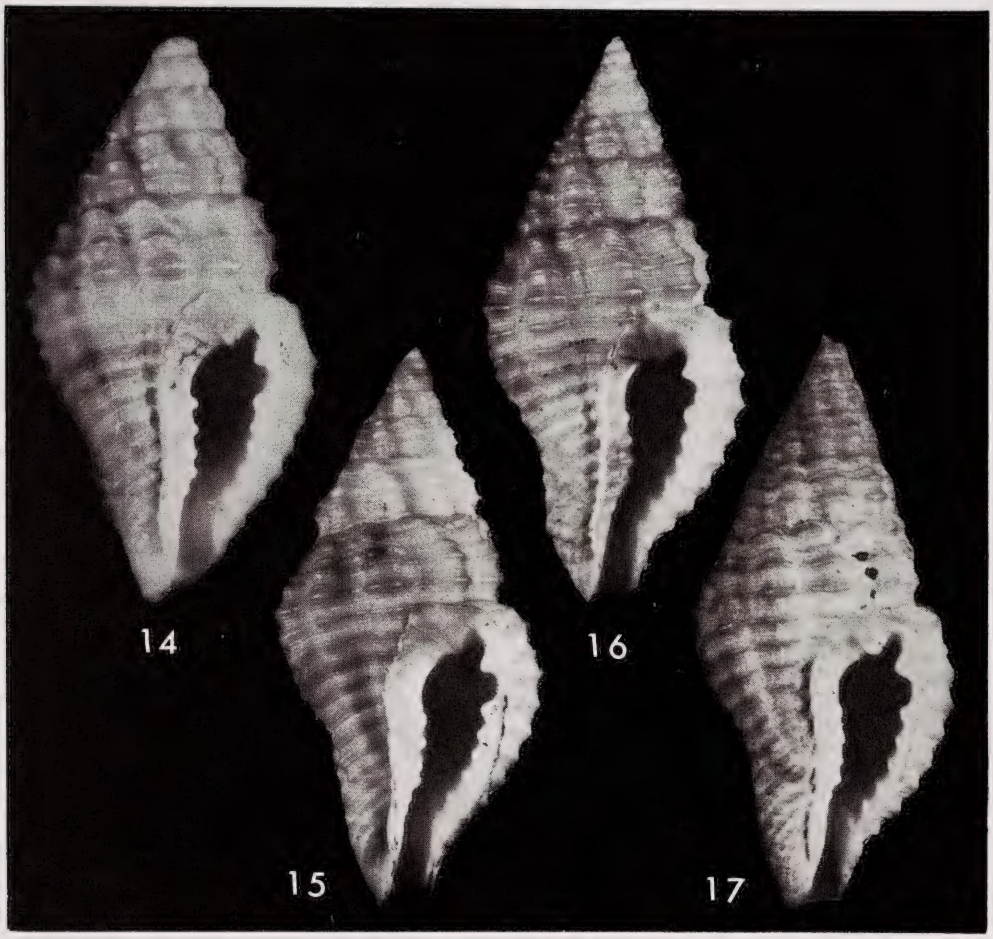
Engina contracta (Reeve, 1846) (Figs. 14-17)

1846. *Ricinula contracta* Reeve, Conch. Iconica, 3: pl. 5, fig. 32 (Panama and St. Elena, W. Columbia = error).

1846. *Ricinula acuminata* Reeve, Conch. Icon., 3: pl. 6, fig. 52 (Hab:?).

1883. *Engina contracta* Reeve, Tryon, Man. Conch., 5: 193, pl. 62, figs. 41, 42 (with *Ricinula acuminata* Reeve, placed in synonymy); 1909 Dall, Proc. U.S. Nat. Mus., 37: 214 (Gulf of Panama to Guayaquil = error); 1911 Schepman, Siboga-Exped., 49d: 309 (various stations in Indonesia, 9-45 metres); 1971 Keen, Sea shells trop. W. America, ed. 2, pp. 563, 905 (figd. syntypes).

1915. *Engina gannita* Hedley, Proc. Linn. Soc. N.S.W., 39 (4): 732, pl. 84, fig. 87 (off Darnley Id., Torres Strait, 30 fathoms); 1972 Ponder, J. Malac. Soc. Aust., 2 (3): 252, pl. 24, fig. 6 (figd. holotype).



Figs. 14-17. 14. *Engina contracta* (Reeve). Syntype B.M.N.H. No. 1968481; length 13.7 mm, width 7.0 mm. 15, 16. *E. acuminata* (Reeve) Syntype B.M.N.H. No. 1968464. 15. Length 14.8 mm, width 7.2 mm 16. Length 13.1 mm, width 6.3 mm. 17. *E. gannita* Hedley, from Darnley I., Torres Str., 30 fathoms (55 m). Paratype B.M.N.H. No. 1915.12.31.113, length 14.3 mm, width 6.5 mm.

Reeve (1846) originally described the species from the west coast of America, and the west American locality was cited by Tryon (1883), who retained *Engina* in the Columbellidae, and by Dall (1909). Keen (1971) tentatively cited *E. contracta* in her list of rejected and indetermined species and indicated that further research on the species is required.

Schepman (1911) examined several dredged specimens from Indonesia which he thought were *E. contracta,* but being unsure of his determination, due to the west American locality, sent them to E. A. Smith of the British Museum. Smith confirmed the Indonesia specimens as *E. contracta,* and considered Reeve's locality indication an error. During a recent visit to the British Museum (Nat. Hist.), the writer was able to compare the type specimens of the taxa in question. It was found that the 4 worn and orange faded syntypes of *Ricinula contracta* Reeve, B.M.N.H. No. 1968481, were

conspecific with the 2 syntypes of *R. acuminata* Reeve, B.M.N.H. No. 1968464, from unknown locality, and also a paratype of *Engina gannita* Hedley, B.M.N.H. No. 1915.12.31.113, from Darnley I., Torres Strait. The holotype of *E. gannita* Hedley, as figured by Ponder (1972) has stronger and more continuous spiral cords which are less prominently interrupted by the intruding axial ribs, than the paratype in the British Museum. A specimen from harbour dredgings in Apia, Samoa, Hedley's (1915) record from the Torres Strait and Schepman's (*op. cit.*) record from Indonesia, confirm the subtidal species as of tropical Indo-Pacific origin.

The species attains a length of about 15.0 mm, is acuminate and sculptured with axial ribs and overriding spiral cords which are nodulose upon the ribs; the interspaces have additional 3-4 fine spiral striae. The aperture is typical of *Engina,* with its broad, lirate columellar pad and convex, denticulate columella. The lirate parietal wall and bulging and often protruding columella are so typical of all Caribbean, West American and Indo-Pacific *Engina* species, that those species lacking this feature should not be admitted in the *Engina* group. Fresh specimens of *E. contracta* are usually reddish-brown in colour.

A similar species *Peristernia thaanumi* Pilsbry & Bryan, 1918, from the Hawaiian Islands, resembles *Engina contracta* according to the description, but the original illustrations are not detailed enough to be certain whether the species is an *Engina, Peristernia* or even *Pollia.*

Genus **Phos** Montfort, 1810

Subgenus **Strongylocera** Mörch, 1852

Strongylocera Mörch, 1852, Cat. Conchyl. Yoldi, 1: 80. Type species by SD (Cossmann, 1901) *Buccinum cancellatum* Quoy & Gaimard, 1833 (non Gravenhorst, 1807) = *B. textum* Gmelin, 1791.

Shell 15.0 mm-30.0 mm in length, solid, sculptured with prominent axial ribs and weaker spiral threads, later whorls angulate or subangulate at the presutural ramp, sutures adpressed. Nucleus with 3-3½ smooth, white whorls, last nuclear whorl with 4-6 axial riblets. Anterior canal short, deeply emarginate, siphonal fasciole broad, corded, fossa moderately shallow or deep and with a single spiral thread which connects dorsally on to the siphonal notch. Columella descending vertically and bearing a basal fold which is bordered by a groove and an adjacent swelling, posterior part of parietal wall with 2-5 weak ridges in adult individuals. Anterior of outer lip with shallow or deep "stromboid" notch, interior of outer lip strongly lirate (Figs. 18, 19).

Operculum typically buccinoid, corneous, light brown, pointed at both ends, sculptured with concentric growth lines, nucleus undefined. Radula buccinid, rachiglossate, formula 1-1-1, ribbon 2.8 mm in length in a shell 19.0 mm long, with 57 transverse rows of teeth, last 12 rows stained brown. Rachidians with 3 cusps, laterals bicuspid, hind cusp slender, curved and long (Fig. 24).

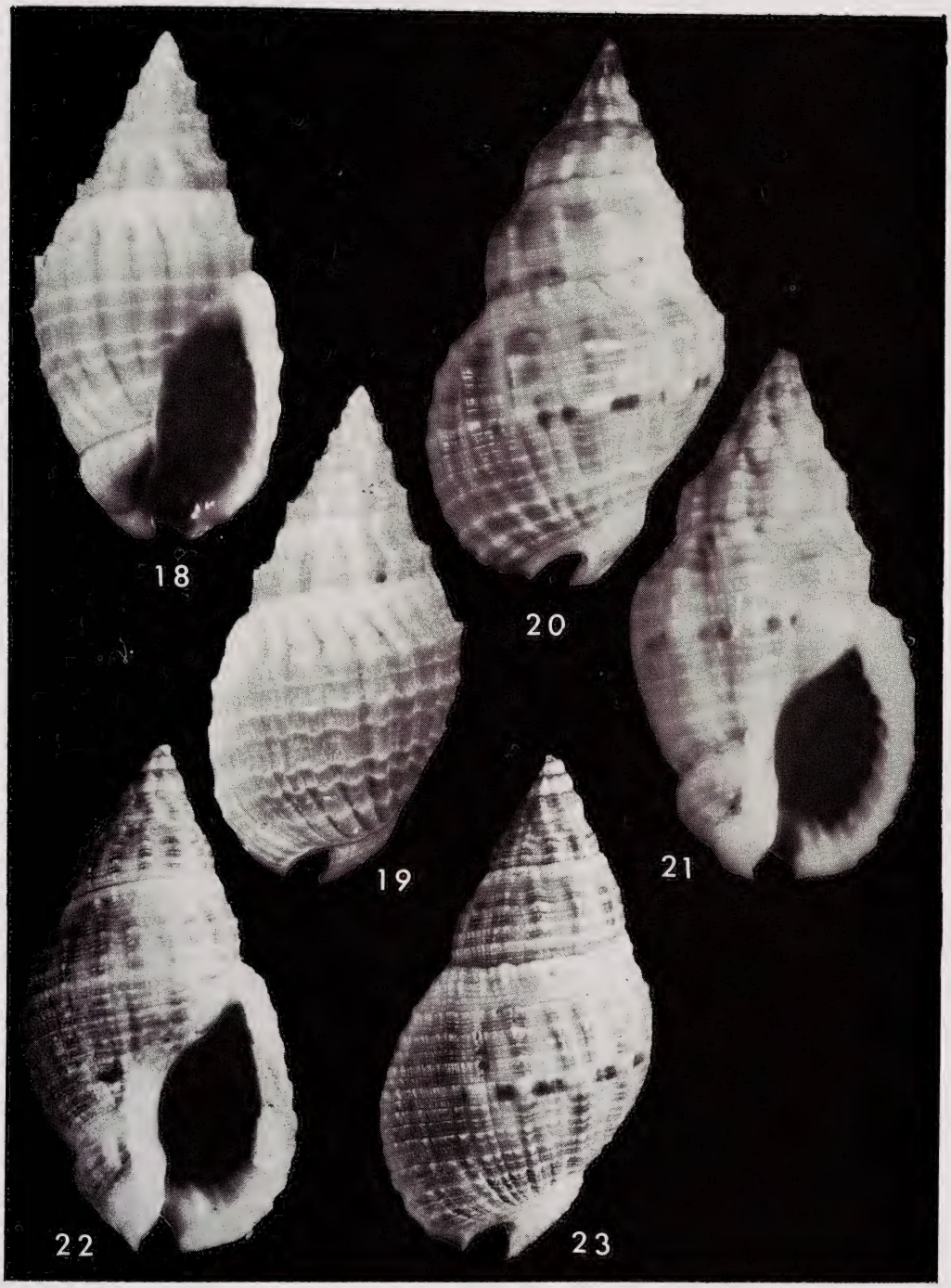
Buccinum textum Gmelin, the type species of *Strongylocera* Mörch, shows considerable generic affinities with the Caribbean species cited in literature as either *Phos unicinctus* (Say, 1827) or *P. guadelupensis* (Petit de la Saussaye, 1852). This affinity has been already pointed out last century by Tryon (1881), Dall (1889) and

Guppy and Dall (1897). On comparing the generic diagnosis of *Strongylocera* Mörch, with that of *Engoniophos* Woodring, 1928, we find them to agree in every diagnostic detail except one: the parietal wall of *Engoniophos* has only a single ridge (as in *Phos. s. str.*) but in *Strongylocera* the parietal wall has from 2-5 ridges or plicae, but only a single ridge in juvenile specimens.

Over 100 specimens of *Phos (Strongylocera) textum* collected by the author in the New Hebrides, where the species is common in clean and weedy coral sand of the intertidal zone, were examined. It was found that while certain characters were variable, others were surprisingly constant. The siphonal fasciole, when heavily calloused, gave rise to a deep fossa, and if weakly calloused resulted in a shallow fossa. The "stromboid" notch on the anterior of the outer lip was either deep or very shallow and the presutural ramp of the body whorl either angulate or weakly sub-angulate. All specimens had only a single basal fold, but the adjacent swelling was either so prominent as to give the impression of a second fold or so weak as to be almost obsolete. Characters which have previously been regarded as constant and worthy of differentiation, i.e. depth of the "stromboid" notch, depth of the fossa, and angulation of the body whorl, were found to be all highly variable in a large series of specimens.

Nassa pallida Powys, 1835, described from Panama, was considered by Keen (1971) to be a *Phos* of Indo-Pacific origin. This species, which generically resembles *P. textum* has not been recognised from the Indo-Pacific region by recent writers except for Faustino's (1928) listing of the species from the "Philippines". Tryon (*op. cit.*) listed *Nassa pallida* Powys as an "American" species from "Panama", and placed *Phos notatus* Sowerby, 1859, from the "Philippines" in synonymy of *Phos pallidus.* He also remarked on their similarity to *Phos textum* (Gmelin) and *P. unicinctus* (Say). Dall (*op. cit.*) echoed Tryon's sentiments when he remarked on the considerable resemblance between *P. unicinctus* and *P. pallidus.*

During an examination of the type specimens of Nassariidae in the British Museum (Nat. Hist.), I came across 3 syntypes of *Nassa pallida* Powys, originally described from Panama, 6 fathoms (11 m), with a note attached "Curacao, *fide* Schepman". Whoever appended the note was correct in assuming that these types were not of Indo-Pacific origin but Caribbean. The syntypes are creamy-white in colour with a dark-spotted narrow central zone on the body whorl, and sculptured with *c.* 10 axial ribs on the penultimate and the same number on the body whorl; the spiral sculpture consist of 8 spiral threads on the penultimate and 16 threads on the body whorl. The columella has a single fold with an adjacent swelling and the interior of the outer lip has 11 strong lirae. The dimensions of one of the syntypes illustrated in fig. 21 are length 25.7 mm, width 13.7 mm, height of aperture 13.6 mm, and of the other syntype illustrated in fig. 20, length 28.2 mm, width 15.5 mm, height of aperture 15.3 mm. The two syntypes of *Phos notatus* Sowerby, described from the "Philippines" are also in the British Museum (Nat. Hist.) and appear to be conspecific with *P. pallidus,* except that the axial ribs are more slender and the shoulder is less angulate. The illustrated syntype (Figs. 22, 23) measures length 24.8 mm, width 13.3 mm, height of aperture 14.2 mm. *Phos pallidus* (Powys) is therefore not of Indo-Pacific origin but is conspecific with the Caribbean *Phos guadelupensis* (Petit de la Saussaye, 1852), originally described as a *Nassa,* and *P. unicinctus* of authors (? not of Say, 1827).



Figs. 18-23. 18, 19. *Phos (Strongylocera) textum* (Gmelin). Malapoa Pt., Efate I., New Hebrides; length 20.7 mm, width 10.5 mm. 20, 21. *P. (?Strongylocera) pallidus* (Powys). Syntypes B.M.N.H. 20. Length 28.2 mm. 21. Length 25.7 mm 22, 23. *P. notatus* Sowerby. Syntype B.M.N.H., length 24.8 mm.

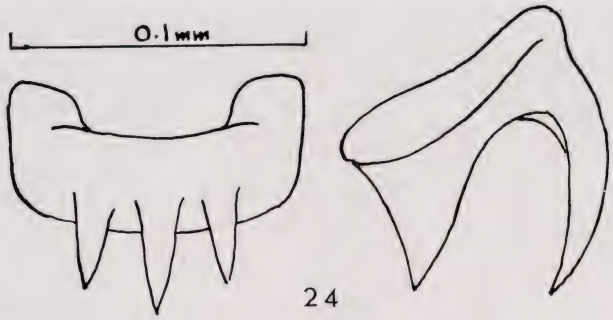


Fig. 24. *Phos (Strongylocera) textum* (Gmelin). Radula — half of one transverse row.

Dall (*op. cit.*) considered Say's locality indication of South Carolina for *Nassa unicincta* as accidental or erroneous, and placed *Nassa guadelupensis* in synonymy of *N. unicincta*. Warmke & Abbott (1961) list and illustrate both species, but point out that they may be conspecific. Woodring (1964) regards *Nassa unicincta* Say as a *nomen dubium* and points out that the species has not been illustrated, the type specimen seems to be lost, the description is not too convincing of the Caribbean *N. guadelupensis* Petit, and the given locality is South Carolina. If Woodring's argument is accepted by authors, then *Phos pallidus* (Powys, 1835) would be an earlier name for *P. guadelupensis* (Petit).

Phos pallidus Powys (= *guadelupensis* Petit) is in our opinion a photine buccinid and not a nassarid belonging to *Pallacera* Woodring, 1964, as suggested by Woodring (*op. cit.*), since the type-specimen of *Nassa myristicata* Hinds, 1844, the type-species of *Pallacera,* differs widely from *Phos pallidus*. The Indo-Pacific *P. textum* and the Caribbean *P. pallidus* display a remarkable similarity of diagnostic features in the angulate or subangulate whorls, protoconch, sculpture, adpressed sutures, vertically descending columella, absence of a nassarid parietal denticle, emarginate siphonal canal, and swollen siphonal fasciole with a spiral thread in the fossa. The radula of *P. pallidus* is unknown to me, but *P. textum* has a typically buccinid photine radula with tri-cuspid rachidians (Fig. 24). *Nassarius myristicatus* on the other hand, has a nassarid radula, 7 plications on the columella apart from a strong parietal denticle and lacks the photid-like elongate aperture, subangulate or angulate whorls and the single columellar fold + swelling. The generic placement of the species requires further study to determine whether it belongs to the buccinid *Engoniophos* Woodring, 1928, as suggested by Warmke & Abbott (*op. cit.*), *Pallacera* Woodring, in the Nassariidae (Woodring, 1964; Keen, 1971) or *Strongylocera* Mörch, from which it differs only in the number of plications on the parietal wall and geographical distribution.

Family MITRIDAE

Genus **Cancilla** Swainson, 1840

Subgenus **Ziba** H. & A. Adams, 1853

Ziba H. & A. Adams, 1853, Gen. Rec. Moll., 1: 179. Type species by SD (Wenz, 1943) *Mitra (Ziba) carinata* Swainson = *M. carinata* Swainson, 1824.

Cancilla (Ziba) bantamensis (Oostingh, 1939) (Figs. 25, 26)

1939. *Mitra (Strigatella) bantamensis* Oostingh, Ingen. Nederl.-Indie, 6 (4): 47, pl. 11, figs. 199-205 (Tjirantjabeureum, Sth. Bantam, Java, Pliocene of Indonesia).

Figs. 25, 26. *Cancilla (Ziba) bantamensis* (Oostingh). 25. Tjirantjabeureum, Bantam, Pliocene of Java, Indonesia; holotype, length 19.0 mm, width 7.0 mm (after Oostingh, 1939, pl. 11, figs. 199a, b). 26. Off Nancowry, Great Nicobar, Nicobar Is., intertidal; length 16.0 mm, width 6.7 mm (ZMC).

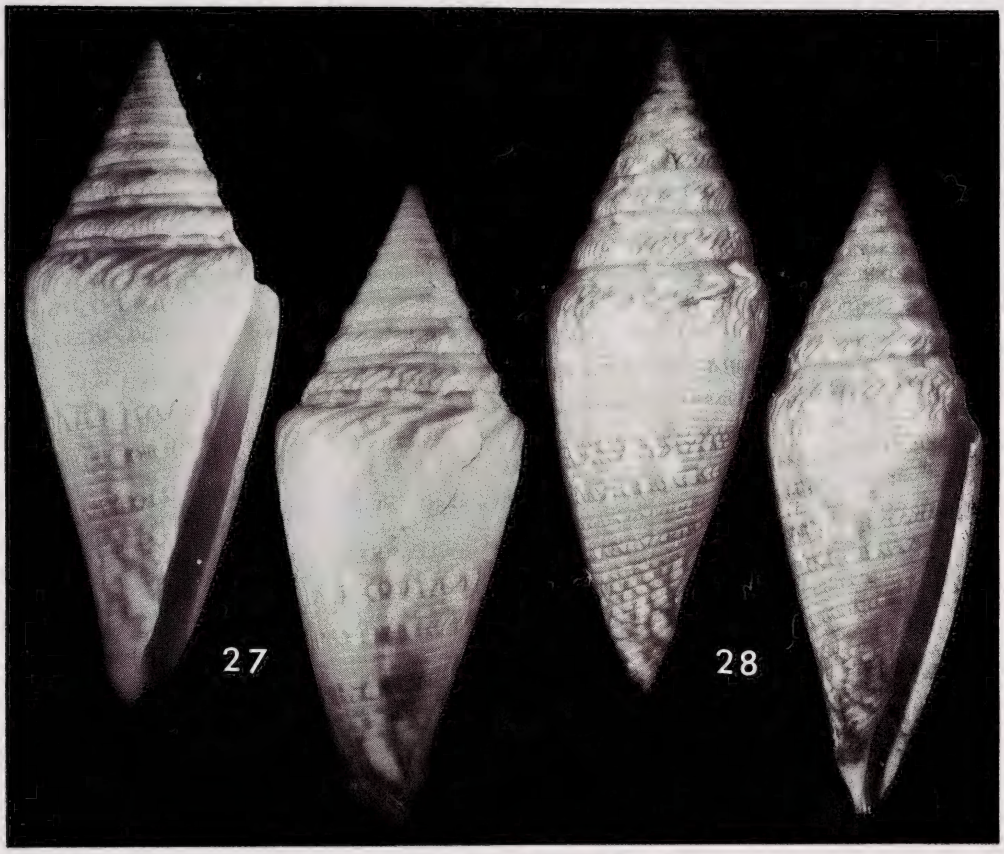
A single specimen of this species, previously known only from Pliocene deposits of Java, has been collected by the "Galathea" expedition at Galathea Bay, off Nancowry, Great Nicobar, Nicobar Islands, intertidally in muddy sand in 1951 (Zool. Mus., Copenhagen).

A detailed description of the fossil specimens of the species is given by Oostingh (1939). The recent, live-taken example is light brown in colour, in parts even fawn, and the aperture and columella are off-white. The spire whorls have a sloping presutural ramp till they reach the prominently angulate single spiral cord and then drop vertically to the suture. The shoulder of the body whorl has an angulate spiral cord and 2 very shallow and almost obsolete spiral grooves with axial lirae; the centre of the body whorl has 5-6 finely incised and pitted spiral grooves which are followed by about a dozen spiral cords which are axially striate in the interspaces. The aperture is longer than the spire, slightly angulate near the start and weakly constricted basally; the columella is weakly calloused and has 5 oblique folds which decrease in size towards the base, siphonal notch distinct. The dimensions of the specimen are length 16.0 mm, width 6.7 mm, height of aperture 10.0 mm.

Family CONIDAE

Genus **Conus** Linnaeus, 1758

Conus Linnaeus, 1758, Syst. Nat., ed. 10, p. 712. Type species by SD (Children, 1823) *C. marmoreus* Linnaeus, 1758.



Figs. 27, 28. *Conus excelsus* Sowerby. 27. Holotype probably from New Caledonia, B.M.N.H., length 88.4 mm, width 34.0 mm. 28. Holotype of *C. pulcherrimus* Brazier, and *Asprella tannaensis* Cotton, from Tanna I., New Hebrides; South Aust. Mus., Adelaide, No. D-6172, length 80.0 mm, width 27.2 mm.

Conus excelsus Sowerby, 1908 (Figs. 27, 28)

1894. *Conus pulcherrimus* Brazier, Proc. Linn. Soc. N.S.W., ser. 2, 9: 187 (Tanna, New Hebrides) [*non* Heilprin, 1879].

1908. *Conus excelsus* Sowerby, Ann. Mag. Nat. Hist., ser. 8, 1: 465, textfig. (New Caledonia?).

1945. *Asprella tannaensis* Cotton, Rec. Sth. Aust. Mus., 8 (2): 270, pl. 4, fig. 3 (Tanna, New Hebrides) [as *A. tennaensis* on plate expl.].

When Tomlin (1937) cited literature references for *C. pulcherrimus* Brazier, he not only gave the erroneous page number 94, but also suggested that the species has been made the type species of *Kenyonia* Brazier, 1896. Tomlin's assumption was incorrect since *Kenyonia pulcherrima* Brazier, 1896, is not the same as *Conus pulcherrimus* Brazier, 1894 (Brazier 1894, 1896) but is a 28.0 mm long turrid similar to *Conopleura* Hinds, 1844.

Cotton (1945) re-described the species as *Asprella tannaensis,* basing his description on the unique holotype of *C. pulcherrimus* Brazier, in the Kenyon collection of

the South Australian Museum, Adelaide, No. D-6172, length 80.0 mm, width 27.2 mm, height of aperture 52.1 mm. Cotton (*op. cit.*), also illustrated the operculum together with the holotype of *Asprella tannaensis*. The holoype, however, is a worn and faded specimen with 3-4 mm of the outer lip broken off and minute worm perforations on the ventral side of the shell. It is obvious that the shell was collected in beach-worn condition, devoid of the living animal, and the operculum which accompanies the holotype, evidently belongs to some other species.

Although *C. pulcherrimus* Brazier, 1894, is a primary homonym of *C. pulcherrimus* Heilprin, 1879, Cotton's *Asprella tannaensis* cannot be retained because of a prior description of *C. excelsus* Sowerby, 1908. The holotype of *C. excelsus,* also faded and worn, is in the British Museum (Nat. Hist.); the dimensions are length 88.4 mm, width 34.0 mm. The type of *C. excelsus* is somewhat broader than the type of *C. pulcherrimus,* but both are nevertheless conspecific.

The recently described *Turriconus nakayasui* Shikama & Habe, 1968, from Kashiwajima, Japan, appears to be closely similar, indeed if not conspecific with *C. excelsus* Sowerby. *T. nakayasui* having been described from apparently fresh specimens, has a brownish base colour and 3 white zones on the body whorl of an almost identical pattern as in *C. excelsus* and *C. tannaensis,* where the base colour has faded to yellow. These two species also show the features of a concave presutural ramp, the single peripheral cord with an adjacent smaller cord on the last 2-3 whorls, high spire and narrow aperture, and 15 whorls. The only difference between the type specimen of *C. excelsus* and *C. tannaensis* and *C. nakayasui,* and a feature which is highly variable in *Conus* species, is the number of spiral grooves on the body whorl: 22 in *C. nakayasui* according to the authors, *c.* 35 in *C. tannaensis* and *c.* 40 in *C. excelsus.*

Conus excelsus Sowerby has been collected in New Caledonia and the New Hebrides, and recently has been reported from off Burma, Bengal (Hawaiian Shell News, 1972, 20 (4): 7). The Burmese shell closely resembles the holotype of *C. excelsus.*

Conus moluccensis [Küster, 1838] (Figs. 29-34)

1795. *"Conus moluccensis"* Chemnitz, Syst. Conch. Cab., 11: 63, pl. 183, figs. 1780-81 Moluccas I.) [*non binom.*].

1817. *Conus moluccensis* "Chemnitz", Dillwyn, Desc. Cat. Rec. shells, 1: 421 (refers to Chemnitz, *op. cit.*, figs. 1780-81) [validity of name being considered by the I.C.Z.N.].

1838. *Conus moluccensis* Küster, Syst. Conch. Cab., ed. 2, 4 (2): 121, 181, pl. 23, figs. 4, 5 (Moluccas Ids.).

1843. *Conus stainforthii* Reeve, Conch. Icon., 1: pl. 1, figs. 1a, b (Hab:?); 1849 Reeve, Conch. Icon., Suppl. p. 3 (*C. stainforthii* synonymised with *C. moluccensis*).

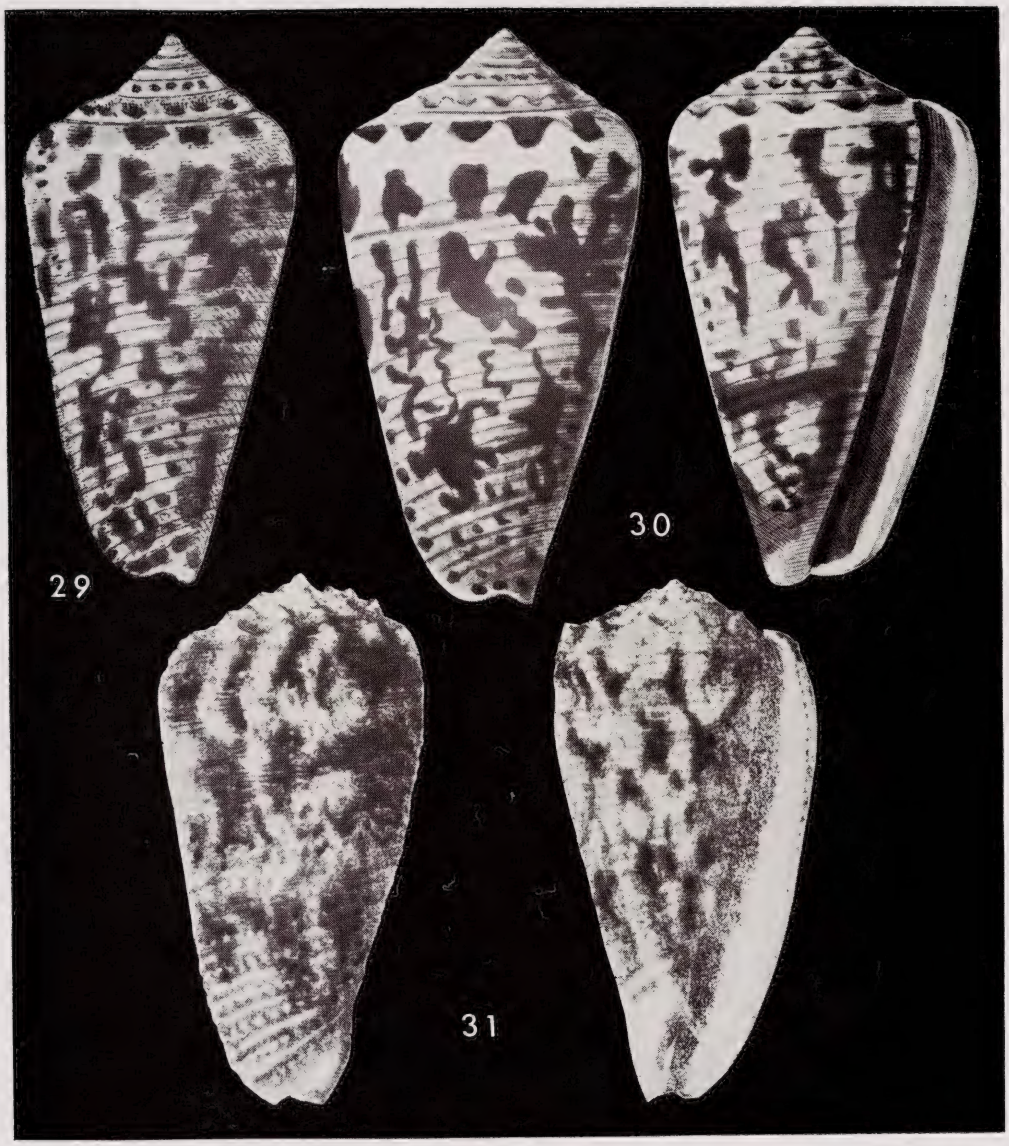
1857. *Conus moluccensis* Chemn., Sowerby, Thes. Conchyl., 3: 3, pl. 3 (189), fig. 46.

1873. *Conus moluccensis* Hwass, Weinkauff, Syst. Conch. Cab., ed. 2, 4 (2): 394 *(C. proximus* Sowerby questionably placed in synonymy).

1969. *Conus* sp. Anonymous, Hawaiian Shell News, 17 (2): 6, fig. on left (off Taganak I., Sth. Palawan, Philippines, 40-45 fathoms) [pustulose form].

1970. *Conus moluccensis* (Küster), Schelling, Hawaiian Shell News, 18 (8): 6, textfig. (Okinawa, 150 feet — spirally grooved all over).

1973. *"Conus merleti"* Anonymous, Hawaiian Shell News, 21 (7): 3, textfig. (New Caledonia, 150 feet) [*nomen nudum*?].



Figs. 29, 31. *Conus moluccensis* [Küster]. 29. Illustration from Chemnitz, 1795, pl. 183, fig. 1780. 30. Illustration from Küster, 1838, pl. 23, figs. 4, 5. 31. Type figure of *C. stainforthii* Reeve (after Reeve, 1843, pl. 1, figs. 1a, b).

Considerable confusion surrounds the identity of the species which has been usually confused with *C. proximus* Sowerby, in literature. The species was first described by Chemnitz (1795) from the Molucca Islands, Indonesia. His original description is as follows:

> "The cone has a thick, strong shell, a white base colour, and is encircled by dark reddish, small and large blotches. The moderately deep spiral grooves carry numerous deep punctae. The many spiral grooves give rise to granulose and nodulose spiral threads on the surface. Between the knots (= coronations) reddish flecks are discern-

ible. The projecting spire is encircled by concentric striae; the interior walls are white. The cone shell has been named *moluccensis* because it has been found in the Molucca Islands." [Free translation].

Chemnitz did not cite any measurements but the figure indicates a length of 43.0 mm. The two views illustrated by Chemnitz do not show the coronations very clearly and no pitting of the grooves is discernible apart from an indication of some granulose spiral cords near the base. The type specimen could not be found in the University Zoological Museum. Chemnitz's non-binominal taxon is not available for taxonomic purposes, and the next probably valid introduction of the name *C. moluccensis* into literature is by Dillwyn (1817). Dillwyn cited the name in his discussion of *C. augur* and appended figure citations to Chemnitz (*op. cit.*). Because of the ambiguity of the style of erection of *C. moluccensis* by Dillwyn, a request for a ruling on the authorship of *C. moluccensis* is pending with the International Commission on Zoological Nomenclature (Cernohorsky, 1974).

Küster (1838) in his revision of the Conidae, once again introduced the taxon into literature, referred to the illustrations and prior description in Chemnitz (*op. cit.*), and appended the following description:

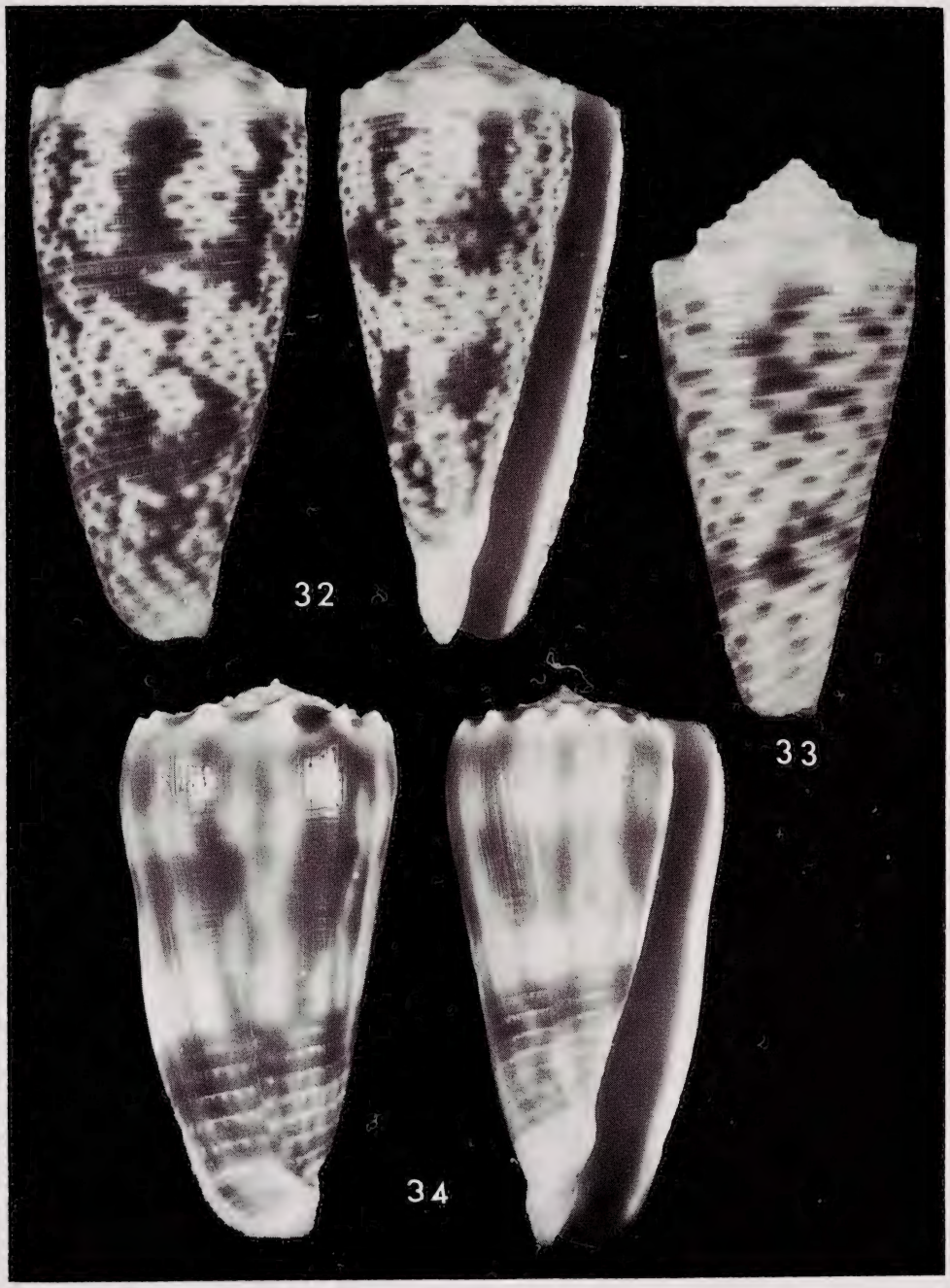
"Shell moderately small, thick and heavy, coniform, surface coronate, sculptured with deepened spiral striae which carry numerous, and to the naked eye hardly discernible punctae. At the base the spiral striae become real grooves. The body whorl is broadly coniform and ends in a pointed spire. The 7 coronate whorls are hardly offset and encircled by concentric striae. Aperture slightly widened, base rounded, siphonal canal notched and oblique. The base colour is white and the shell is encircled by many dark reddish, small or large spots, spire whitish with reddish spots between coronations, aperture white. Length 19 lines [= 41.4 mm], width 10 lines [21.8 mm]. According to Chemnitz the Molucca Islands." [Free translation].

On page 181, the following additional references were cited: Kiener, [1845], p. 49, pl. 75, fig. 2; Sowerby [1857], Thes. Conchyl., pl. 3, fig. 46; *C. stainforthi* Reeve [1843] Conch. Icon., pl. 1, fig. 1.

Küster slightly expanded Chemnitz's original description and although he copied Chemnitz's figures, he improved on them by depicting the spire coronations more realistically (Fig. 30).

Reeve (1843) described *C. stainforthii* from unknown locality, and depicted a granulose form of *C. moluccensis,* which apart from the usual reddish colouring also had some purplish markings. In 1849, Reeve (1849) placed his *C. stainforthii* in the synonymy of *C. moluccensis.* Only the empty box without the type specimen of *C. stainforthii* was found in the British Museum (Nat. Hist.).

Subsequent authors usually confounded the species with *C. proximus* Sowerby, 1859, a very similar yet quite distinct species (for morphological differences see under *C. proximus*). Specimens of *C. moluccensis* are rare and the actual range of variability can only be estimated from the few known specimens. In juvenile individuals the spire is conical and almost flat-sided but becomes lower and concave with maturity. In juveniles the sculpture consists of very strong spiral cords which become smaller, granulose and less elevated in adults. In the smooth form from Okinawa and occasionally New Caledonia, usually labelled *"Conus merleti"*, a description we have been unable to trace, the spiral cords are usually replaced by punctate spiral grooves on the upper



Figs. 32-34. *Conus moluccensis* [Küster]. 32. Specimen from unknown locality (pustulose form); length 46.3 mm, width 21.3 mm. 33. Near Matupi I., Rabaul, New Britain, dredged; juvenile specimen, length 37.9 mm, width 18.2 mm. 34. Bolo Pt., Okinawa, Ryuku Is., 32½ fathoms (59 m); length 44.4 mm, width 22.6 mm.

two-thirds of the body whorl, and the typical spiral cords with axially lirate or punctate grooves are visible on the lower third of the body whorl. The sculpture in *Conus* is often variable and smooth and granulose forms are known in *C. planorbis* Born, 1778, *C. catus* Hwass in Bruguière, 1792, *C. floridulus* Adams & Reeve, 1848, *C. sponsalis* Hwass in Bruguière, 1792, and many others. In not fully mature specimens, the shoulder is angulate but becomes more roundly angulate in adult specimens. All adults have an emaciated outer lip which is slightly constricted in its upper third. In some specimens from Okinawa, the spiral sculpture is almost obsolete on the upper half of the body whorl. Both Chemnitz and Küster described the shell as white with reddish ornamentations, and specimens examined showed a colour range varying from bright orange-red, reddish-brown to dark reddish-brown.

Adult specimens measure from 40.0 mm-50.0 mm. The presently known range of the species is from Indonesia to Okinawa, New Britain and New Caledonia, at depth ranging from 20-45 fathoms (37-82 m), and no records are known from the Fiji Islands.

Specimens illustrated as *C. moluccensis* in the Hawaiian Shell News (1972, 20 (9): Suppl. 7) from Tonga, are *C. boeticus* Reeve, and having been printed in reverse show a sinistral aperture.

Conus proximus Sowerby, 1859 (Figs. 35-38)

1854. *Conus pulcher* A. Adams, Proc. Zool. Soc. London, for 1853, pt. 21: 117 (New Caledonia) [non *C. pulcher* Lightfoot, 1786].

1857. *Conus pulcher* A. Adams, Sowerby, Thes. Conchyl., 3: 13, pl. 6 (192), fig. 121.

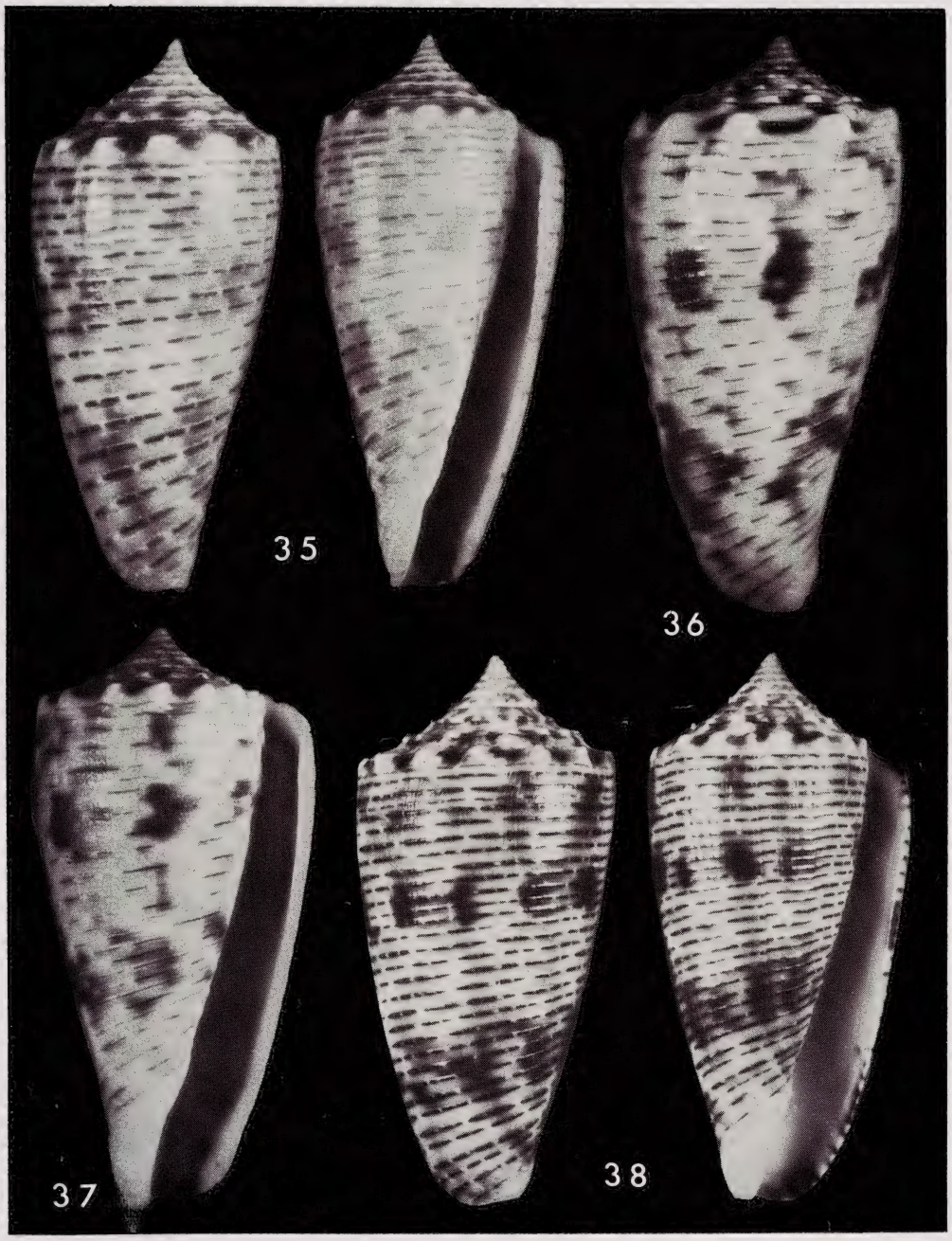
1859. *Conus proximus* Sowerby, Proc. Zool. Soc. London, pt. 27: 429, pl. 49, fig. 1 (Hab:?)

1964. *Conus moluccensis* Küster, Marsh & Rippingale, Cone shells world, p. 139, pl. 19, fig. 15; 1964 Cernohorsky, Veliger, 7 (2): 81, pl. 17, fig. 53; 1967 Cernohorsky, Marine shells Pacific, 1: 222, pl. 57, fig. 423; 1792 Hinton, Shells New Guinea & Indo-Pacific, p. 88, pl. 43, figs. 21-23; 1973 Leehman, Hawaiian Shell News, 21 (7): 9, top textfig., 2 spec. on right only (*non C. moluccensis* Küster, 1838).

Because of its superficial similarity to *C. moluccensis* Küster, and lack of specimens of the latter for comparison, the two species have usually been considered to be conspecific. *C. pulcher* was first described by A. Adams (1854) from New Caledonia, and later the species was once again described as *C. proximus* by Sowerby (1859) from unknown locality. I have examined the holotype of *C. pulcher* A. Adams, in the British Museum (Nat. Hist.), length 22.1 mm, width 10.0 mm, and compared it with the 3 syntypes of *C. proximus* Sowerby, in the same Institution, and found them to be conspecific. One of the syntypes of *C. proximus* measures length 31.3 mm, width 15.2 mm. C. *pulcher* A. Adams, 1854, being a primary homonym of *C. pulcher* Lightfoot, 1786, is taxonomically not available, and *C. proximus* Sowerby, is the next available name for the species.

The differences in shell morphology between *C. moluccensis* and *C. proximus* are as follows.

Size and shape. Adult specimens of *C. moluccensis* range from 40.0 mm-50.0 mm, those of *C. proximus* from 20.0 mm-45.0 mm in length, with 30.0 mm being the average size. The width:height ratio is about the same in both species, with 46%-54%



Figs. 35-38. *Conus proximus* Sowerby. 35. Holotype of *C. pulcher* A. Adams; B.M.N.H., length 22.1 mm, width 10.0 mm. 36, 37. Syntype of *C proximus* Sowerby; B.M.N.H., length 31.3 mm, width 15.2 mm. 38. Marau Sound, Guadalcanal, Solomon Is., 20 fathoms (37 m); length 31.0 mm, width 15.0 mm.

of length in *C. moluccensis* and 45%-51% in *C. proximus*. The outer lip in adult *C. moluccensis* is constricted in its upper third but is straight or even slightly convex in *C. proximus*.

Sculpture. This is the most important difference between the two species. In *C. moluccensis* the sculpture consists of either 30-45 moderately strong, granulose spiral cords and occasional finer intermediate threads and prominent axially lirate intervening grooves; in the smooth form the cords are replaced by finely pitted spiral grooves and the cords and lirate grooves are confined to the lower third of the body whorl. In *C. proximus* the pitted or lirate grooves are absent, and the sculpture consists of 25-40 fine, elevated spiral threads and smooth interspaces. In some individuals, however, there are very fine close-set longitudinal growth-lines which appear as weak striae in the last 4-5 grooves at the base. The basal columellar fold is more prominent and calloused in *C. moluccensis* than in *C. proximus*. The coronations are stronger and more erect in *C. moluccensis* but flatter in *C. proximus*.

Colour. *C. moluccensis* has a white base colour and predominantly reddish axial flames and streaks arranged in rather ill-defined 2-3 transverse bands on the body whorl, and the aperture is white. In *C. proximus* the base colour is either cream or light fawn in fresh specimens and the ornamentation is dark brown to blackish-brown with no trace of red at all, and consists of interrupted lines upon the spiral threads which are usually interspersed with small white spots, and small blotches which are arranged in 2, rarely 3, transverse rows. The aperture is not white, but pale blue or light violet. Both species have from 3-6 finer spiral threads and arcuate axial striae on the spire whorls.

C. proximus occurs more frequently in Melanesia, especially Tonga, Fiji, New Caledonia, New Hebrides, Solomon Islands and New Guinea. It is found to a depth of 20 fathoms (37 m), but several specimens have been collected by the author in only 6 feet (2 m) in muddy sand, in the Fiji Islands.

Acknowledgements. The loan of specimens received from Dr J. Knudsen, University Zoological Museum, Copenhagen, Mr D. C. Lee, South Australian Museum, Adelaide, Miss H. Eker and Miss E. Wright, Sanibel Island, Florida, and Mr E. Leehman, Aiea, Hawaii, is gratefully acknowledged. I would like to express my thanks to Dr J. Taylor, Mr J. Peake and Mr K. Thomas, British Museum (Natural History), London, and Dr H. A. Rehder, National Museum of Natural History, Washington, for facilities which they so kindly made available and for access to their respective collections.

REFERENCES

ADAMS, A.

1854 Descriptions of new species of the genus *Conus*, from the collection of Hugh Cuming, Esq. *Proc. Zool. Soc. London* for 1853 (21): 116-119.

BAYLE, E.

1880 Liste rectificative de quelques noms de genres at d'espéces. *J. Conchyl.* 28: 240-251.

BRAZIER, J.

1894 Notes and Exhibits. *Proc. Linn. Soc. New South Wales* (2): 9-187.

1896 A new genus and three new species of Mollusca from New South Wales, New Hebrides, and Western Australia. *Proc. Linn. Soc. New South Wales* (2): 11-347.

CERNOHORSKY, W. O.

1974 Request for a ruling on the authorship of *Conus moluccensis* (Mollusca, Gastropoda) Z.N. (S.). *Bull. zool. Nomencl.* (in press).

CHEMNITZ, J. H.

1795 *Neues systematisches Conchylien-Cabinet.* Nürnberg, G. N. Raspe. 11: 1-312; pl. 174-213.

COTTON, B. C.

1945 A catalogue of the Cone shells (Conidae) in the South Australian Museum. *Rec. Sth. Aust. Mus.* 8 (2): 229-280; pl. 1-5.

DALL, W. H.

1889 Reports on the results of dredging . . . by the U.S. coast steamer "Blake" . . . *Bull. Mus. Comp. Zool. Harvard* 18: 1-492; pl. 10-40.

1909 Report on a collection of shells from Peru, with a summary of the littoral marine mollusca of the Peruvian zoological province. *Proc. U.S. Nat. Mus.* 37: 147-294; pl. 20-28.

DILLWYN, L. W.

1817 *A descriptive catalogue of Recent shells, arranged according to the Linnaean method.* London, J. & A. Arch. 1: 1-580; 2: 581-1092.

FAUSTINO, L. A.

1928 *Summary of Philippine marine and fresh-water mollusks.* Manila, Bureau of Printing. 384 pp.

GUPPY, R. J. L. and W. H. DALL

1897 Descriptions of Tertiary fossils from the Antillean region. *Proc. U.S. Nat. Mus.* 19: 303-331; pl. 27-30.

HEDLEY, C.

1915 Studies on Australian Mollusca. Part XII. *Proc. Linn. Soc. New South Wales* 39 (4): 695-755; pl. 77-85.

KEEN, A. M.

1971 *Sea shells of tropical West America.* Ed. 2. Stanford University Press. pp. 1-1064; pl. 1-22; textfigs.

KUESTER, H. C.

1838 *Systematisches Conchylien-Cabinet von Martini und Chemnitz. Familie der Coneae oder Conidae.* Ed. 2. Nürnberg, Bauer & Raspe. 4 (2): 121, 181, pl. 23, figs. 4, 5.

OOSTINGH, C. H.

1939 Die Mollusken des Pliocäns von Süd-Bantam in Java. *Ingen. Nederl.-Indie,* IV, *Mijnb & Geol.* 6 (4): 47; pl. 11.

PONDER, W. F.

1972 Notes on some Australian species and genera of the family Buccinidae (Neogastropoda). *J. Malac. Soc. Australia* 2 (3): 249-265; pl. 24-25; textfigs.

REEVE, L. A.

1843-44. *Conchologia Iconica; monograph of the genus Conus.* London. 1: pl. 1-47; Index.

1846 *Conchologicia Iconica; monograph of the genus Ricinula.* London. 3: pl. 1-6; Index.

1848-49 *Conchologia Iconica; Supplement to the genus Conus.* London. pp. 1-7; pl. 1-9.

SCHEPMAN, M. M.

1911 The Prosobranchia of the Siboga Expedition. Part IV. Rachiglossa. *Siboga-Expeditie* 49d: 247-363; pl. 18-24.

SHIKAMA, T. and T. HABE

1968 A new Japanese Cone, *Turriconus nakayasui* with reference to *Embrikena stupa* group. *Venus: Jap. J. Malac.* 26 (3/4): 57-59; pl. 6.

SOWERBY, G. B.

1859 Descriptions of new species in the collection of H. Cuming. *Proc. Zool. Soc. London* 1859 (27): 428-429; pl. 49. (published between October 1859-February 1860).

TOMLIN, J. R. le B.

1937 Catalogue of Recent and fossil Cones. *Proc. Malac. Soc. London* 22: 205-330.

TRYON, G. W.

1881 *Manual of Conchology*. Philadelphia. 3: 1-310; pl. 1-87.

1883 *Manual of Conchology*. Philadelphia. 5: 1-276; pl. 1-63.

WARMKE, G. L. and R. T. ABBOTT

1961 *Caribbean Seashells*. Narbeth, Livingston Publ. Co. pp. 1-346; pl. 1-44.

WOODRING, W. P.

1964 Geology and Paleontology of Canal Zone and adjoining parts of Panama. *Geol. Surv. Prof. paper* No. 306-C; 241-297; pl. 39-47.

TYPE SPECIMENS OF MOLLUSCA IN THE UNIVERSITY ZOOLOGICAL MUSEUM, COPENHAGEN

W. O. CERNOHORSKY
AUCKLAND INSTITUTE AND MUSEUM

Abstract. The present study includes 60 species of marine Mollusca which were described and illustrated by Martini & Chemnitz in the "Systematisches Conchylien-Cabinet" between the years 1769-1795, with the exception of the type-specimen of *Voluta virgo* Linnaeus, from the Spengler collection. The type-specimens of the species dealt with are primarily gastropods belonging to the families Fissurellidae, Patellidae, Trochidae, Stomatellidae, Turbinidae, Neritidae, Naticidae, Cymatiidae, Muricidae, Buccinidae, Melongenidae, Fasciolariidae, Mitridae, Vexillidae, Turridae, Conidae and the bivalve family Veneridae.

During a recent visit to the University Zoological Museum in Copenhagen, I had the opportunity to examine 60 type-specimens of species illustrated in Martini & Chemnitz's "Neues systematisches Conchylien-Cabinet". Most of the specimens illustrated in this work from 1780-1795, originated from the Spengler and Moltke collections. These historical types, which have already been segregated from the general collection, are housed in a separate cabinet in a fire-proof room of the Museum. The collection is fairly large and particularly rich in bivalves, and most lots bear the original old and also new labels.

The enumeration of the 60 species dealt with in this paper follows in systematic order. A brief account of the history of the "Conchylien-Cabinet" and the collections associated with it, is given.

HISTORY OF THE "CONCHYLIEN-CABINET"

Friedrich Heinrich Wilhelm Martini (1729-1778), a physician from Hamburg, and ardent conchologist, found the lack of readily available books on conchology a source of frustration. In the latter half of the 18th century he decided to author his own work on conchology, which he envisaged would run into several volumes and treat all the then known species of molluscs. G. N. Raspe (1712-1785), a publisher from Nürnberg, promised to publish the work, and well-known collectors of the day, e.g. Feldmann, Meuschen, Bolten and Meiers, promised assistance with finance and specimens.

The first volume of the "Neues systematisches Conchylien-Cabinet" (= The new systematic Conchology-Cabinet) appeared in 1769, and contained 408 pages and 31 colour plates. The size of the publication was 9¼ x 11½ inches (23.5 x 29.2 cm), the text was in German Gothic, and the engraved, hand-coloured plates were printed on laid, watermarked "Van Gelder" paper with wide margins. The specimens illustrated in these plates came from Martini's own collection, from the Royal Academy

of Science, Berlin, and private collections of Eller, Conrad, Feldmann and Spengler. The artist for the plates was A. F. Happe, painter of the Berlin Academy, and the engraver was C. B. Glassbach.

After the appearance of the first volume, several buyers suggested that they expected plates of better quality for a price of 90-100 Thalers. Chemnitz replied and acknowledged that the plates were no masterpieces, but because of the sheer size of the work, and in order to keep the price down, the artists did not exert themselves to capacity. With the appearance of volume 2 in 1773, the quality of the plates improved considerably although the artists remained the same.

Before the appearance of volume 3 in 1777, Martini suffered a painful illness from which he took 2 years to recuperate. The artists for volume 3 were J. Nusbiegel and O. Bischoff, and J. S. Leitner was the engraver.

A year after publication of volume 3, Martini died, and Raspe the publisher, Mrs Martini and her adviser Dr Brehmer chose Johann Hieronymous Chemnitz (1730-1800) to continue the authorship of the "Conchylien-Cabinet". Chemnitz, a German born in Magdeburg, came to Denmark in 1768 as a pastor to the German church in Copenhagen, and already prior to his arrival was a keen student of conchology who had his own collection and was ideally suited to carry on the authorship. Chemnitz, however, refused initially and so did his close friend Lorenz Spengler (1720-1807). Spengler was born in Schaffhausen, Switzerland, and came to Denmark in 1743 as a cabinet-maker and wood-turner to the Danish Court. His knowledge of the secret art of making artificial teeth brought him a considerable income which enabled him to form a fine shell collection through purchase of choice specimens. After their refusal, the publisher then offered the authorship to Walch in Jena, Baron von Zorn in Danzig and Meuschen in the Hague, but they all politely declined. Prof. Boddaert from Leiden, however, was willing to undertake the task provided that he could write the text in Dutch and the publisher would have it translated into German. The terms were found to be unacceptable, and Mrs Martini once again approached Chemnitz imploring him to carry on her husband's legacy. Chemnitz finally relented after having been assured of Spengler's assistance.

When Chemnitz assumed the authorship, he found the 38 plates for volume 4 already completed but not a single line of text had been written. It took Chemnitz one year to write the text and volume 4 was published in 1780. The artist for this volume was Krüger and J. S. Leitner the engraver. Chemnitz promised plates of a better quality in the future by employing a new artist.

Volume 5 appeared in 1781, and the new artist was Franz Scheitel (or Scheidl) from Vienna. Scheitel was the illustrator for Baron N. J. von Jacquin's botanical works, developed eye-trouble in the process, was refused a pension by the Austrian state, and accepted Chemnitz's offer to illustrate the plates for volumes 5-9.

Volume 6 appeared in 1782, and it will be found that some of the plates in this volume are well below standard. Volume 7 was published in 1784 and volume 8 in 1785. Chemnitz reports that Nusbiegel the engraver was employed for the colouring of the figures so that there would be no cause for complaint about the inferior quality of the plates. Volume 9 was published in 1786, and Scheitel the artist returned to his

family in Vienna. The plates for volume 10, which appeared in 1788, were executed by J. P. Degen and the engraver was G. Vogel. Some time after 1790, the Viennese artist Scheitel arrived unannounced at Chemnitz's house in Copenhagen, and in order to provide him with a chance to earn his living, Chemnitz decided to bring out volume 11, containing mainly additions to the previous volumes. The last volume finally appeared in 1795.

The completed 11 volumes contain a total of 4008 pages and 406 plates. Each volume had from 312 to 434 pages and from 31 to 56 plates. The plates in volumes 1-5 were numbered consecutively from 1-193 and in volumes 6-11 from 1-213. Chemnitz intended to publish a catalogue of all species described in the 11 volumes but he died 5 years after the completion of volume 11. This catalogue did not appear until 1840 under the authorship of L. Pfeiffer. An additional twelfth volume in the first edition of the "Conchylien-Cabinet" appeared in 1829 under the authorship of H. G. Schubert and J. A. Wagner, and was published by Bauer & Raspe in Nürnberg.

This giant work, which took 26 years to complete, has been placed on the Official List of Rejected Works in Zoology by the International Commission on Zoological Nomenclature (1958) because the authors did not apply the principles of binominal nomenclature. Martini and Chemnitz's illustrations, however, were cited and names often taxonomically validated by Gmelin (1791), Röding (1798), Holten (1802), Link (1807), Dillwyn (1817), Schumacher (1817), Anton (1839), Pfeiffer (1840), Mörch (1852-53) and other authors.

History of the Collections

The Martini collection

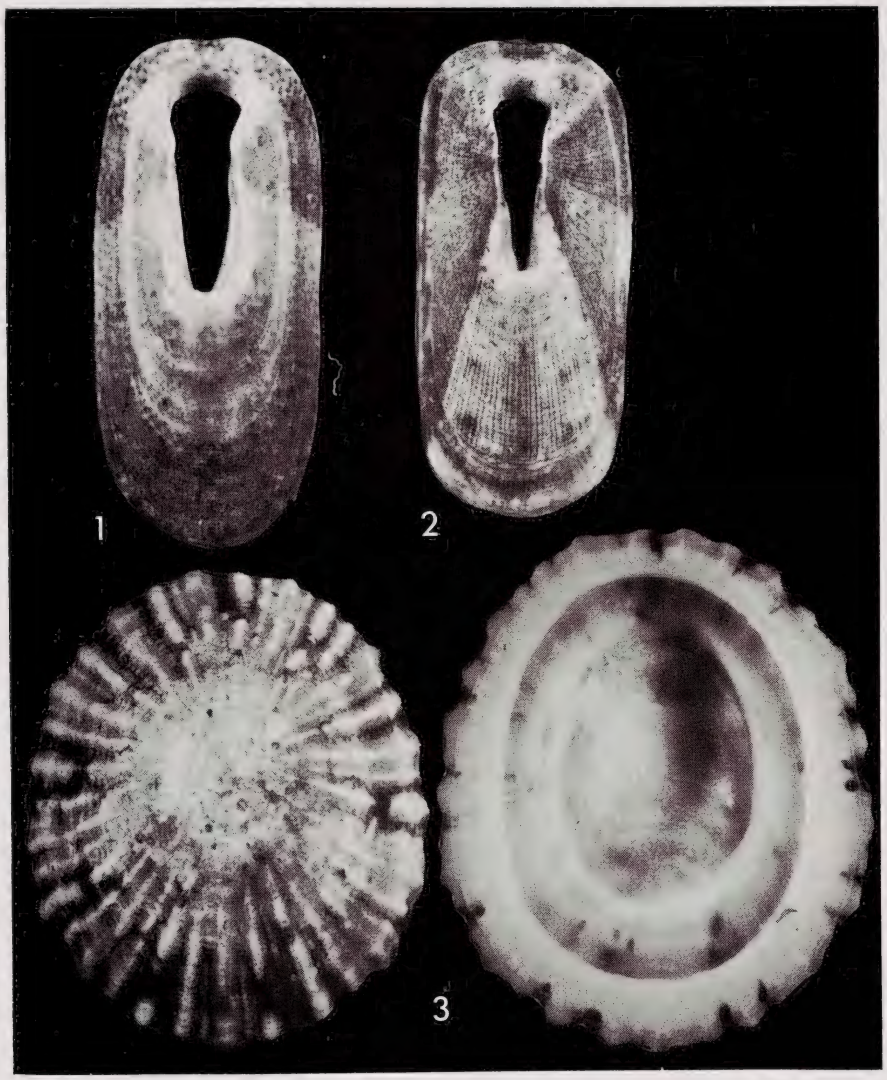
After Martini's death in 1778, the collection of shells became the property of Count von Matuschka from Breslau, Germany, who purchased the collection for 2,500 Reichsthaler, complete with catalogue. According to Pfeiffer (1840), the original specimens owned by Martini and illustrated in the first 4 volumes of the "Conchylien-Cabinet", were at that time the property of Pfeiffer's brother-in-law, a Hermann Nathusius from Hundisburg. When or how Nathusius acquired the collection is unknown and the whereabouts of Martini's collection remains a mystery.

The Chemnitz collection

It is curious to find that after Chemnitz's death the collection was not included in the Royal Natural History Museum but was put up for public auction in Copenhagen. H. S. Holten, a one-time tutor to King Christian VIII of Denmark and for a short time inspector of the Royal Natural History Museum, prepared the catalogue of the sale, which contained 1244 "type lots" of molluscs. Originally advertised for sale on the 7th December 1802, the sale was postponed to the 7th February 1803. Although not known for sure, it is possible that some specimens were purchased at the Chemnitz auction for the Museum.

The Moltke collection

The collection was established around 1750 by Count A. G. Moltke and later continued by his son J. G. Moltke. After the Napoleonic wars in Europe, Denmark went bankrupt and the University found itself in difficulties. In order to assist the University, Count J. G. Moltke purchased the University Natural Theater, amalgamated it with his own collection, and in 1810 presented the two collections to the University.



Figs. 1-3. 1, 2. Syntypes of *Macroschisma macroschisma* (Holten). 1. Length 21.0 mm. 2. Length 16.1 mm. 3. Holotype of *Cellana tramoserica* (Holten); length 37.0 mm.

The Spengler collection

In 1796 a committee was appointed under Abildgaard for the purpose of establishing the Royal Natural History Museum, an event which took place in 1805. The Royal Natural History Museum purchased several collections, and in 1805, two years before his death, acquired Spengler's collection. This Museum was finally amalgamated in 1867 with the University Zoological Museum and occupied a new building at the old University site in the centre of Copenhagen. This building was in use until the collections were transferred to the present building of the University Zoological Museum in 1963. The Museum also acquired King Christian VIII collection after his death in 1848.

Type Selection

Gmelin (1791) did not base his descriptions on actual specimens before him, but repeated, often *verbatim,* the description of other authors and cited appropriate illustrations for his new species. Provided that only a single specimen of the species illustrated and cited by Gmelin is present in the Spengler-Moltke collection, this specimen should be regarded as the holotype. In cases where illustrations by other authors were cited in addition to those by Chemnitz, the specimen or specimens are considered to be syntypes only, but qualify for lectotype selection.

Röding (1798) did not offer an actual diagnosis of new species established in his sales catalogue but simply cited illustrations which appeared to match the actual specimens before him from the Bolten collection. All type-specimens of species validated by Röding and referred to an illustration in Chemnitz, qualify only as syntypes.

Lamarck, in several of his publications, based his description of new species on specimens in his own collection and many of his types are still extant in the Muséum d'Histoire Naturelle, Geneva, and the Muséum National d'Histoire Naturelle, Paris.

Dillwyn (1817) in the Introduction to his work states that he was attempting to arrange a small cabinet of shells, and it is probable that some of these specimens may have served as the basis for his description of new species. The same applies to Schumacher (1817) who not only owned specimens but also had access to the original Spengler-Moltke material at the Copenhagen Museum. All specimens of species described by Schumacher which bear the initial "Sch" inside the aperture, can be presumed to have originated from the Schumacher collection, and all other type material from the Spengler-Moltke collection. The type specimens of species described by Dillwyn and referred to specimens in the Spengler-Moltke collection are considered to be only syntypes, as are those species established by Schumacher and referred to Chemnitz, and which were not represented by Schumacher's own specimens.

The synonymy of the species enumerated contains only entries directly pertaining to the type-specimens and subjective synonyms have been omitted in most cases. The specific heading shows the genus-group to which the species is currently assigned. The dimensions cited are height x width or height x width x height of aperture, expressed in mm.

Family FISSURELLIDAE

Macroschisma macroschisma (Holten, 1802) (Figs. 1, 2)

1795. *"Patella macroschisma"* Chemnitz, Syst. Conch. Cab., 11: 184, pl. 197, figs. 1923-24 (Japan) [*non binom.*]

1802. *Patella macroschisma* Holten, Enum. syst. Conch. Chemnitzii, p. 86 (refers to Chemnitz, *op. cit.,* figs. 1923-24 [non Lightfoot, 1786]

1851. *Macroschisma maxima* A. Adams, Proc. Zool. Soc. London, for 1850, pt. 18: 202 (Hab:?)

Dimensions of syntypes: 21.0 x 9.5 mm (the specimen illustrated by Chemnitz) and 16.1 x 7.3 mm; shell with numerous close-set axial threads and spiral striae.

Patella macroschisma Holten, 1802, is a primary homonym of *P. macroschisma* Lightfoot, 1786, and *Macroschisma maxima* A. Adams, 1851, is an available substitute name. The species lives in Japanese waters.

Family PATELLIDAE

Cellana tramoserica (Holten, 1802) (Fig. 3)

1795. *"Patella tramoserica"* Chemnitz, Syst. Conch. Cab., 11: 179, pl. 197, figs. 1912-13 (New South Wales) [*non binom.*]

1802. *Patella tramoserica* Holten, Enum. syst. Conch. Chemnitzii, p. 85 (refers to Chemnitz, *op. cit.*, figs. 1912-13).

Dimensions of holotype: 37.0 x 30.5 mm; shell with whitish, orange and brown ribs, interior tinged with yellow.

The species lives on the southern coastline of Australia.

Family TROCHIDAE

Trochus granularis Röding, 1798 (Fig. 4)

1781. *"Trochus perforatus"* Chemnitz, Syst. Conch. Cab., 5: 96, pl. 170, figs. 1642a, b (*non binom.*)

1798. *Trochus granularis* Röding, Mus. Bolten., p. 81 (refers to Chemnitz, *op. cit.*, figs. 1642a, b)

Dimensions of syntype: 18.2 x 23.4 mm; shell with perforated umbilicus.

Adam & Leloup (1938) place *T. granularis* Röding, in the synonymy of the Indian Ocean *T. radiatus* Gmelin, 1791.

Trochus viridis Gmelin, 1791 (Fig. 5)

1781. *"Trochus perforatus . . . novaezeelandiae"* Chemnitz, Syst. Conch. Cab., 5: 97, pl. 170, figs. 1643-44 (New Zealand) [*non binom.*]

1791. *Trochus viridis* Gmelin, Syst. Nat., ed. 13, p. 3572 (refers to Chemnitz, *op. cit.*, figs. 1643-44) [Hab:?]

1853. *Polydonta viridescens* A. Adams, Proc. Zool. Soc. London, for 1851, pt. 19: 154 (refers to Chemnitz, *op. cit.*, figs. 1643-44) [Capul, Philippines = error].

Dimensions of 2 syntypes: 21.5 x 20.6 mm; smaller immature syntype 15.3 x 16.6 mm.

Adams' (1853) and Faustino's (1928) locality indication of "Capul, Philippines" is an error; the species is endemic to New Zealand.

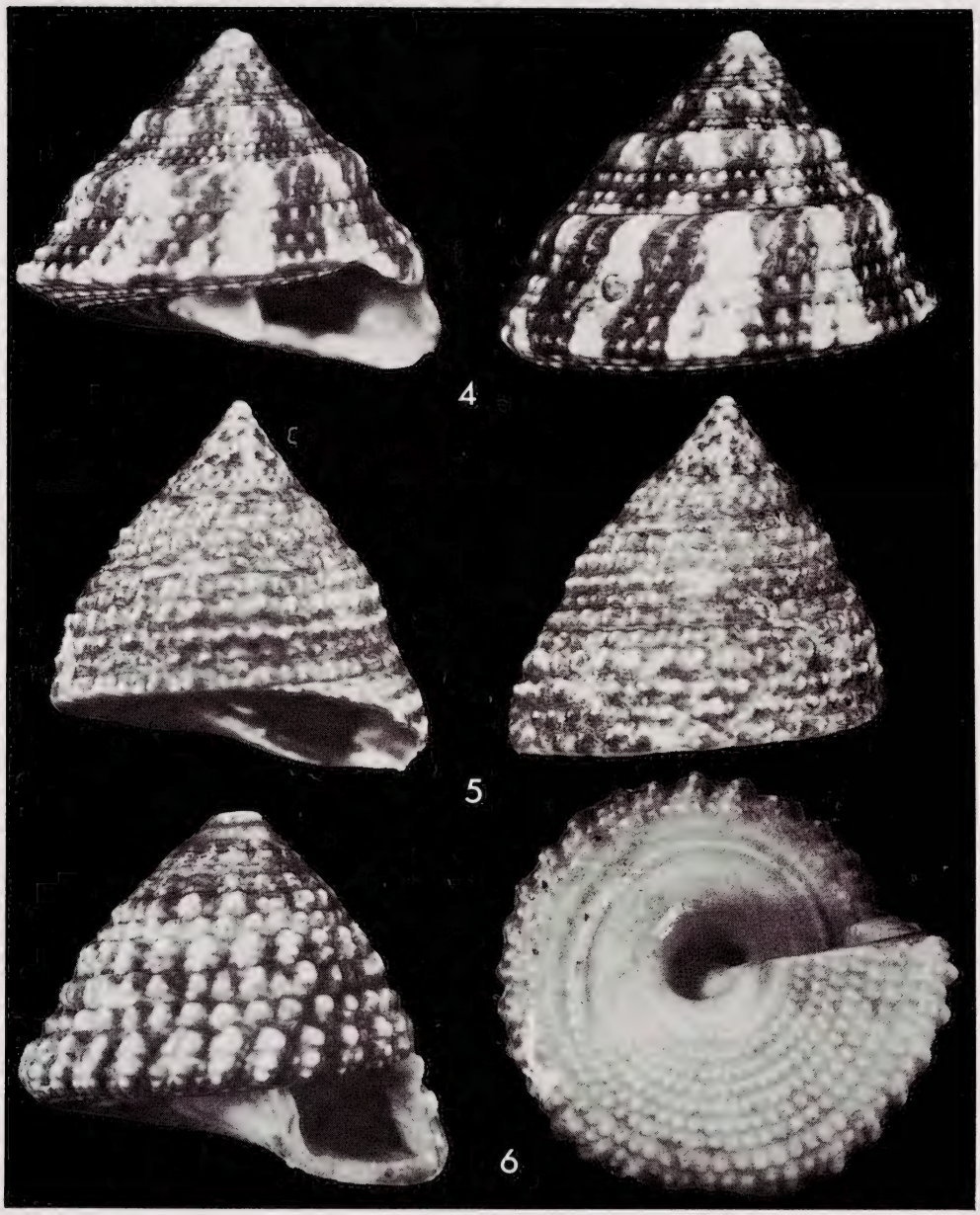
Trochus spengleri Gmelin, 1791 (Fig. 6)

1781. *"Trochus spengleri grandinatus"* Chemnitz, Syst. Conch. Cab., 5: 92, pl. 169, fig. 1631 (Hab:?) [*non binom.*]

1791. *Trochus spengleri* Gmelin, Syst. Nat., ed. 13, p. 3571 (refers to Chemnitz, *op. cit.*, fig. 1631) [Hab:?]

Dimensions of holotype: 23.8 x 27.5 mm; shell with 4 rows of regular-sized nodules, two sutural rows of nodules confluent.

The distribution of the species is unknown, but Pilsbry in Tryon (1889) suggests that it may be an earlier name for the Japanese species *Trochus sacellum* Philippi, 1852.



Figs.. 4-6. 4. Syntype of *Trochus granularis* Röding; length 18.2 mm. 5. Syntype of *T. viridis* Gmelin; length 21.5 mm. 6. Holotype of *T. spengleri* Gmelin; length 23.8 mm.

Calliostoma (Maurea) selectum (Dillwyn, 1817) (Fig. 7)

1795. *"Trochus selectus"* Chemnitz, Syst. Conch. Cab., 11: 168, pl. 196, figs. 1896-97 (coasts of New Zealand) [*non binom.*]

1817. *Trochus selectus* Dillwyn, Desc. cat. Rec. shells, 2: 801 (refers to Chemnitz, *op. cit.*, figs. 1896-97); Wood 1825, Ind. Test., p. 140, pl. 29, fig. 101a.

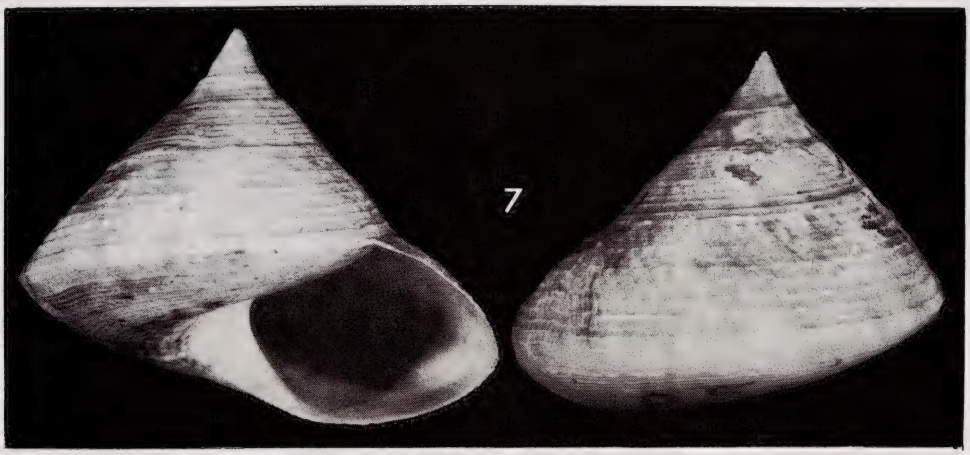


Fig. 7. Syntype of *Calliostoma (Maurea) selectum* (Dillwyn); length 29.7 mm.

1834. *Trochus cunninghami* Griffith & Pidgeon, Anim. Kingd. Bar. Cuvier, Moll. Rad., 12: 600, pl. 1, fig. 7.

Dimensions of syntype: 29.7 x 36.4 mm; shell with 9 spiral threads on the penultimate and 12 threads on the body whorl.

The species is endemic to New Zealand and was previously known as *Maurea cunninghami* (Griffith & Pidgeon). For an expanded synonymy see Cernohorsky (1972).

Diloma novazelandiae (Anton, 1839) (Figs. 8, 9)

1781. *"Pica imperforata novaezeelandiae"* Chemnitz, Syst. Conch. Cab., 5: 230, pl. 185, figs. 1850-51 (New Zealand) [*non binom.*]

1839. *Turbo novazelandiae* Anton, Verz. Conchyl., p. 58 (refers to Chemnitz, *op. cit.*, fig. 1850 and for var. b fig. 1851).

1846. *Trochus zebrinus* Philippi, Zeit. f. Malakozool., 3: 105.

1853. *Labio pica* A. Adams, Proc. Zool. Soc. London, for 1851, pt. 19: 179 (refers to Chemnitz, *op. cit.*, pl. 175 = error for pl. 185, fig. 1850) [New Zealand].

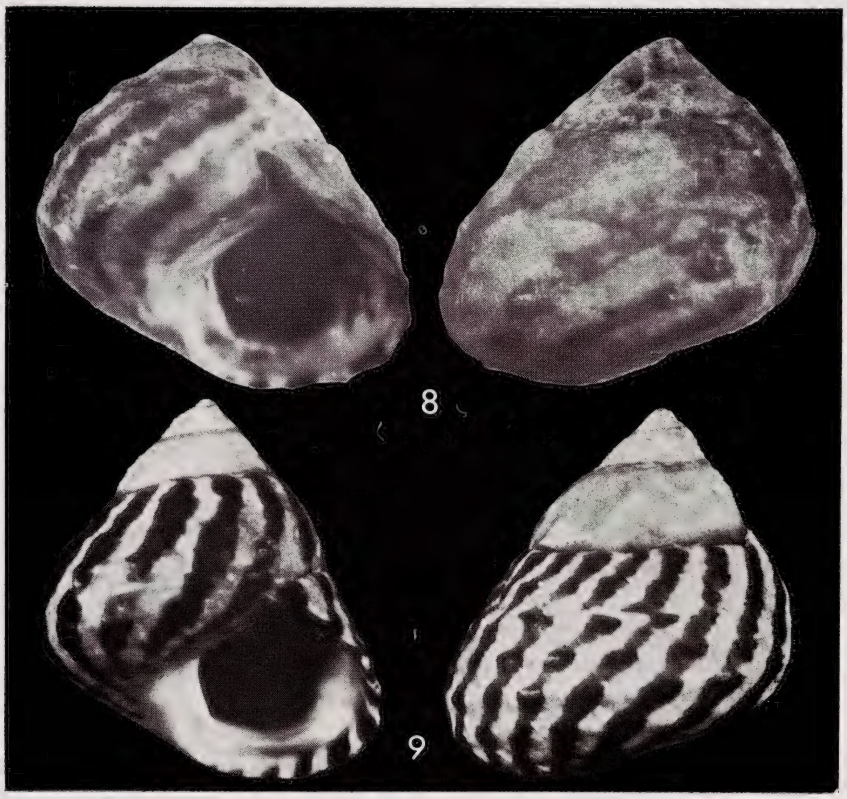
1946. *Zediloma (Fractarmilla) corrosa zebrina* Powell, Rec. Auckland Inst. Mus., 3 (2): 137, pl. 11, figs. 4, 5 (Western Otago, New Zealand) [*non Trochus zebrinus* Philippi, 1846].

Dimensions of syntype (Chemnitz fig. 1850): 12.0 x 12.5 mm (Fig. 8); other syntype (Chemnitz fig. 1851) 14.0 x 12.5 mm (Fig. 9).

Powell's specific name *zebrina* has been anticipated by *zebrinus* Philippi, 1846, whose species is not only congeneric but conspecific with Powell's. The earliest available substitute name is *Turbo novazelandiae* Anton, 1839. The species produces several clines in New Zealand populations and which have been named *Diloma subrostrata* (Gray, 1835), *D. corrosa* and *D. undulosa,* both of A. Adams, 1853, and *D. plumbea* Hutton, 1883.

Melagraphia lugubris (Gmelin, 1791) (Fig. 10)

1781. *"Nodulus lugubris minutus"* Chemnitz, Syst. Conch. Cab., 5: 54, pl. 165, fig. 1571 (coasts of southern continents) [*non binom.*]



Figs. 8, 9. Syntypes of *Diloma novaezelandiae* (Anton). 8. Length 12.0 mm. 9. Length 14.0 mm.

1791. *Trochus lugubris* Gmelin, Syst. Nat., ed. 13, p. 3538 (refers to Chemnitz, *op. cit.*, fig. 1571) [Southern Ocean].

1791. *Turbo aethiops* Gmelin, Syst. Nat., ed. 13, p. 3596 (refers to Born, 1780, p. 340, vig. fig. b and Chemnitz, vol. 5, pl. 182, figs. 1820-21) [Hab:?].

Dimensions of holotype: 12.3 x 14.2 mm; shell with 5 spiral cords on the penultimate and 12 broader cords on the body whorl, cords crossed by oblique striae. Umbilicus imperforate, edge of columella orange, spiral cords spotted with white.

Both specific names are currently in use in New Zealand malacological literature, but the taxon *Trochus lugubris* Gmelin, is being applied to a different monodontine species. The New Zealand species described and illustrated by Tryon (1889) and all subsequent authors as "*Monodonta lugubris* (Gmelin)" is not Gmelin's species but is the species subsequently named *Trochus sulcatus* Wood, 1828 (*non* Lamarck, 1804) = *T. cingulatus* Quoy & Gaimard, 1833 (*non* Brocchi, 1814) = *T. bicanaliculatus* Dunker in Philippi, 1844 = *T. gaimardi* Philippi, 1846 = *T. bernardi* Récluz, 1852 = *Anisodiloma lenior* Finlay [1927]. Although *Trochus lugubris* Gmelin has page precedence over *Turbo aethiops* Gmelin, the latter name is so firmly entrenched in malacological literature that a substitution of *T. lugubris* for *Turbo aethiops* is undesirable. The *Trochus lugubris* of authors, however, will have to be replaced by the next valid available taxon, i.e. *Trochus bicanaliculatus* Dunker in Philippi, 1844.

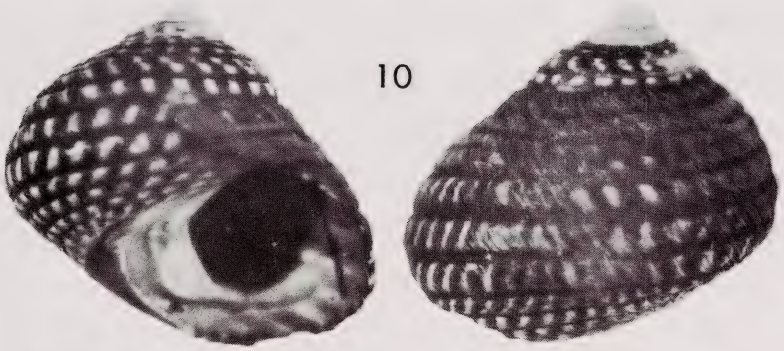


Fig. 10. Holotype of *Melagraphia lugubris* (Gmelin); length 12.3 mm.

The genus-group *Neodiloma* Fischer, 1885 (type-species *Turbo aethiops* Gmelin) and *Anisodiloma* Finlay, [1927] (type-species *Trochus lugubris* Gmelin), become synonyms of *Melagraphia* Gray, 1847 (type-species *Turbo aethiops* Gmelin).

Tegula (Chlorostoma) argyrostoma (Gmelin, 1791) (Fig. 11)

1781. *"Trochus imperforatus niger"* Chemnitz, Syst. Conch. Cab., 5: 51, pl. 165, figs. 1562-3 (South Seas or vicinity = error) [*non binom.*]

1791. *Trochus argyrostomus* Gmelin, Syst. Nat., ed. 13, p. 3583 (refers to Chemnitz, *op. cit.*, figs. 1562-63) [Southern Ocean = error].

1798. *Turbo lithantrax* Röding, Mus. Bolten., p. 81 (refers to Chemnitz, *op. cit.*, figs. 1562-63).

Dimensions of holotype: 34.1 x 38.3 mm; shell sculptured with slanting, curved axial ribs; almost black in colour and with a rusty-brown band at sutures, base brown, becoming silvery towards aperture, umbilicus imperforate.

The various locality indications of South Seas or New Zealand are incorrect. The species is commonly found in Japan and the Philippine Islands.

Family STOMATELLIDAE

Stomatia imperforata (Gmelin, 1791) (Fig. 12)

1779. *Stomatia phymotis* Helbling, Abh. Privatg. Böhmen, 4:124, pl. 2, figs. 34, 35.

1788. *"Haliotis imperforata* Chemnitz, Syst. Conch. Cab., 10: 309, pl. 166, figs. 1600-01 (Red Sea) [*non binom.*]

1791. *Haliotis imperforata* Gmelin, Syst. Nat., ed. 13, p. 3690 (refers to Meuschen, Helbling and Chemnitz, *op. cit.*, figs. 1600-01 [India].

Dimensions of syntype: 29.3 x 33.0 mm.

Haliotis imperforata Gmelin, 1791, is a synonym of *Stomatia phymotis* Helbling, 1779. The species lives in the tropical Indo-Pacific.

Pseudostomatella papyracea (Gmelin, 1791) (Fig. 13)

1781. *"Cochlea lunaris papyracea"* Chemnitz, Syst. Conch. Cab., 5: 215, pl. 182, figs. 1817-19 (East Indies) [*non binom.*]

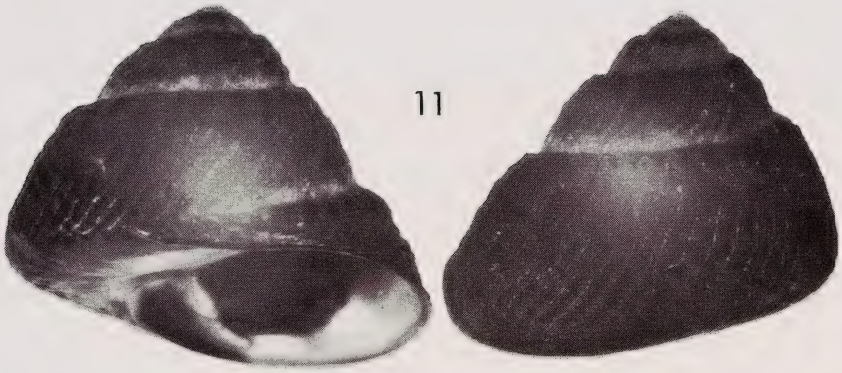
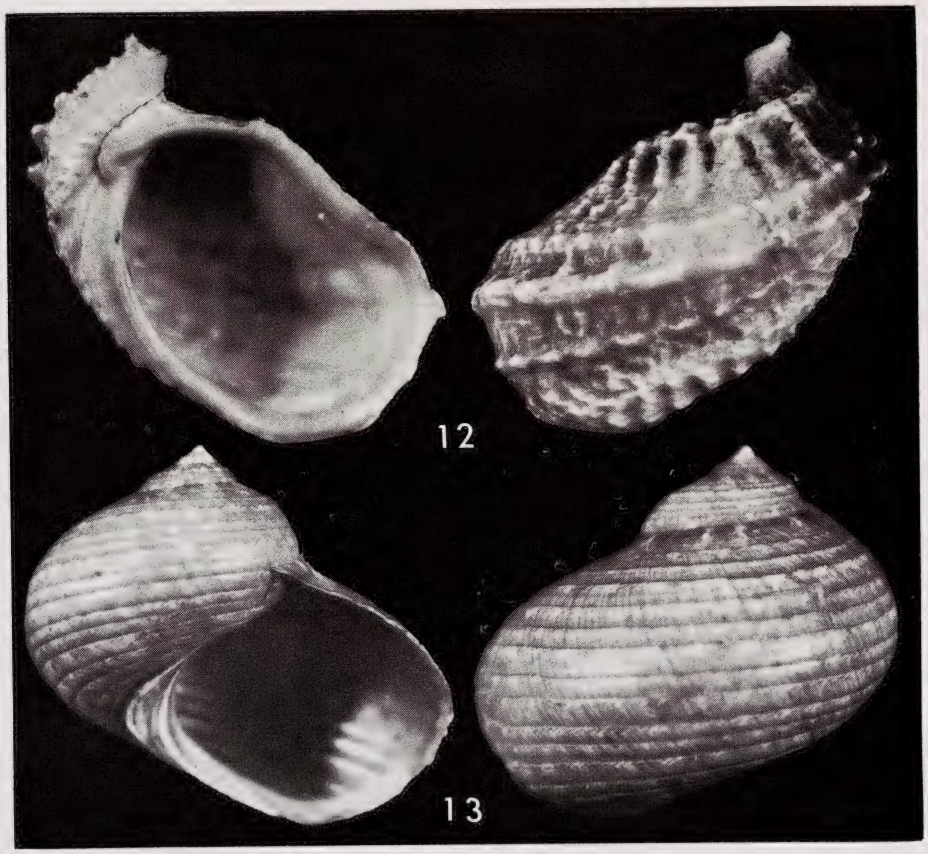


Fig. 11. Holotype of *Tegula (Chlorostoma) argyrostoma* (Gmelin); length 34.1 mm.



Figs. 12, 13. 12. Syntype of *Stomatia imperforata* (Gmelin); length 29.3 mm. 13. Holotype of *Pseudostomatella papyracea* (Gmelin); length 20.3 mm.

1791. *Turbo papyraceus* Gmelin, Syst. Nat., ed. 13, p. 3596 (refers to Chemnitz, *op. cit.*, figs. 1817-18 [Hab:?]

Dimensions of holotype (Chemnitz figs. 1817-18): 20.3 x 24.3 mm; shell with 7 elevated spiral cords on the penultimate and 16 cords on the body whorl.

P. papyracea is an Indo-Pacific species. The specimen illustrated by Chemnitz (*op. cit.*) in fig. 1819 is a different stomatellid species.

Family TURBINIDAE

Turbo radiatus Gmelin, 1791 (Fig. 14)

1781. *"Argyrostomus maris rubri"* Chemnitz, Syst. Conch. Cab., 5: 199, pl. 180, figs. 1788-89 (Red Sea) [*non binom.*]

1791. *Turbo radiatus* Gmelin, Syst. Nat., ed. 13, p. 3594 (refers to Chemnitz, *op. cit.*, figs. 1788-89) [Red Sea].

Dimensions of holotype: 53.5 x 50.2 mm; shell sculptured with 8 spiral cords on the penultimate and 19 cords on the body whorl, 1 keeled cord on the penultimate and 4 cords on the body whorl spinose; aperture silvery, operculum smooth.

Adam & Leloup (1938) consider this species from the Indian Ocean, to be a valid taxon and supply a detailed synonymy.

Turbo imperialis Gmelin, 1791 (Fig. 15)

1781. *"Cochlea lunaris imperialis"* Chemnitz, Syst. Conch. Cab., 5: 200, pl. 180, fig. 1790 (China Seas) [*non binom.*]

1791. *Turbo imperialis* Gmelin, Syst. Nat., ed. 13, p. 3594 (refers to Chemnitz, *op. cit.*, fig. 1790) [China].

Dimensions of holotype: 94.2 x 80.8 mm; shell smooth, umbilicus imperforate, decorticated green with dark green spiral lines.

The species is similar to *Turbo petholatus* Linnaeus, 1758, and is sometimes considered to be a subspecies of the latter. The external colouring is constantly different, and the operculum in *T. imperialis* is white, matt and minutely roughened, whereas it is smooth, glazed, shining and tinged with purple in *T. petholatus*. The species ranges from Japan to Australia, and is moderately frequent at Caloundra, Queensland.

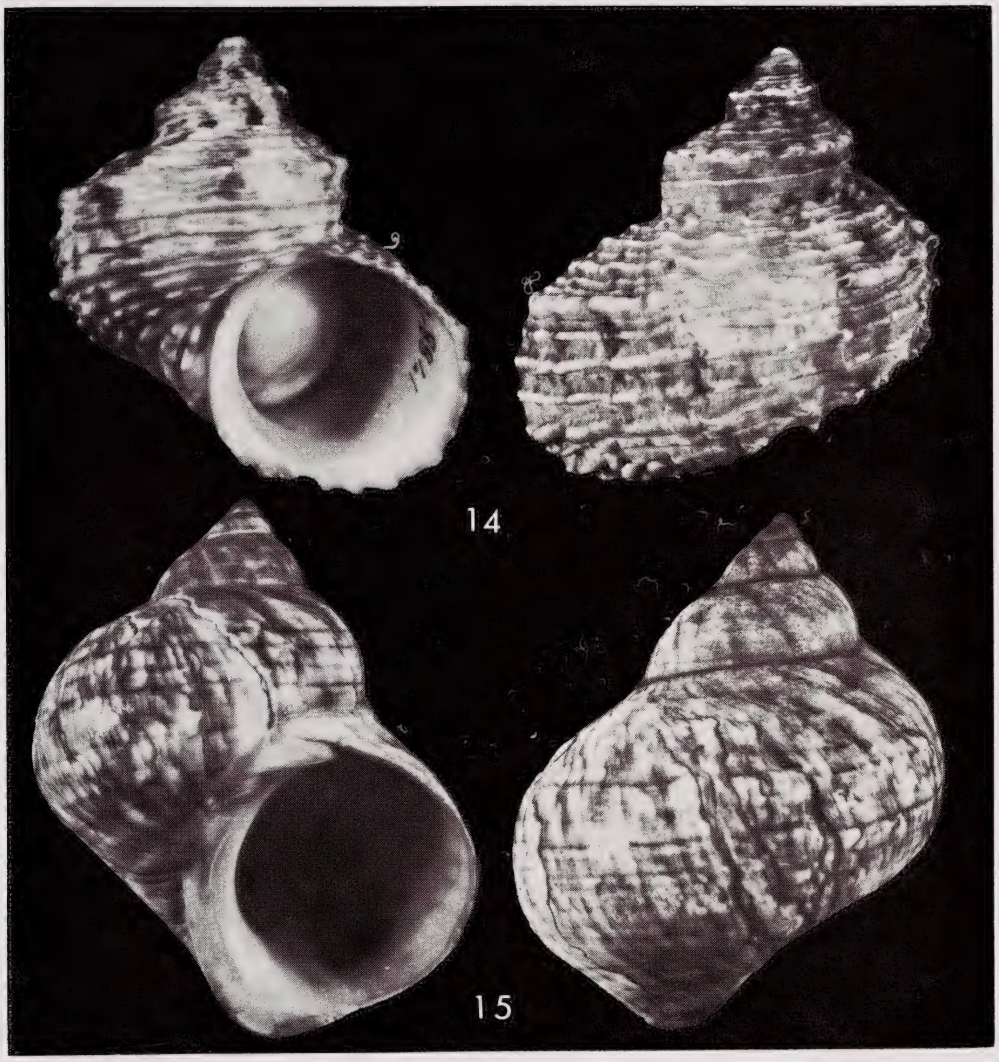
Turbo argentatus (Röding, 1798) (Fig. 16)

1781. *"Argyrostomus canaliculatus"* Chemnitz, Syst. Conch. Cab., 5: 202, pl. 181, fig. 1794 (East Indies) [*non binom.*]

1791. *Turbo canaliculatus* Gmelin, Syst. Nat., ed. 13, p. 3594 (refers to Regenfuss, vol. 1, pl. 10, fig. 44 and Chemnitz, *op. cit.*, fig. 1794) [India] (*non* Hermann, 1781).

1798. *Lunatica argentata* Röding, Mus. Bolten., p. 102 (refers to Chemnitz, *op. cit.*, fig. 1794).

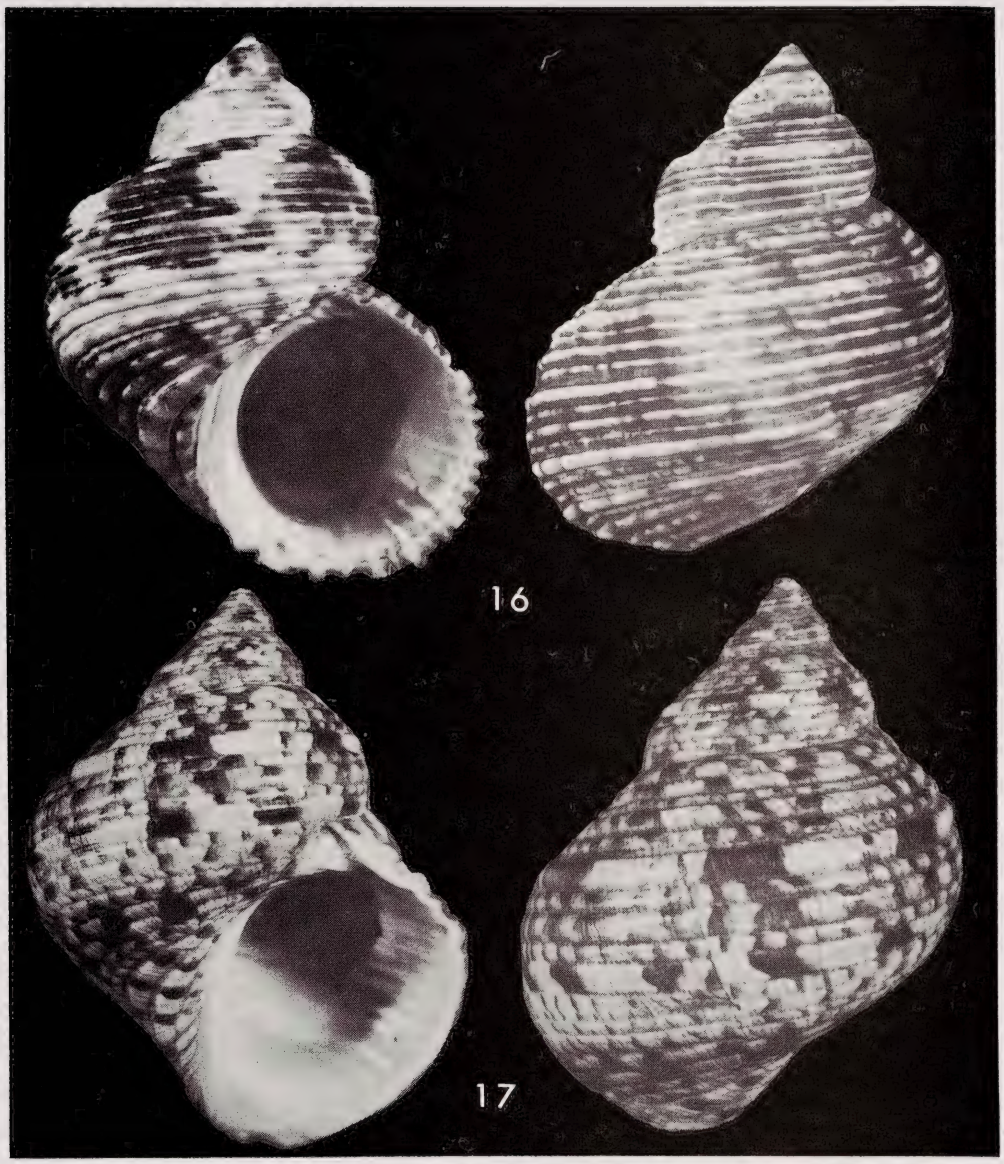
Dimensions of probable syntype: 72.0 x 61.0 mm; shell with 11 prominent spiral cords on the penultimate and 24 cords on the body whorl, interspaces of cords striate, umbilicus imperforate, aperture silvery.



Figs. 14, 15. 14. Holotype of *Turbo radiatus* Gmelin; length 53.5 mm. 15. Holotype of *T. imperialis* Gmelin; length 94.2 mm.

Chemnitz's solitary type specimen does not agree with the illustrated figure, but agrees perfectly with his description. Chemnitz (*op. cit.*) describes the species as strongly sculptured with channels, gutters and striae, and remarks that the colour is white (creamy-white in the actual specimen) and marbled with dark green or reddish-brown flames and spots. The illustration in Chemnitz does not show the heavy sculpture and appears an overall green.

Turbo argentatus appears to be a variant of the Indo-Pacific *T. argyrostomus* (Linnaeus, 1758).



Figs. 16, 17. 16. Syntype of *Turbo argentatus* (Röding); length 72.0 mm. 17. Holotype of *T. sparverius* Gmelin; length 55.7 mm.

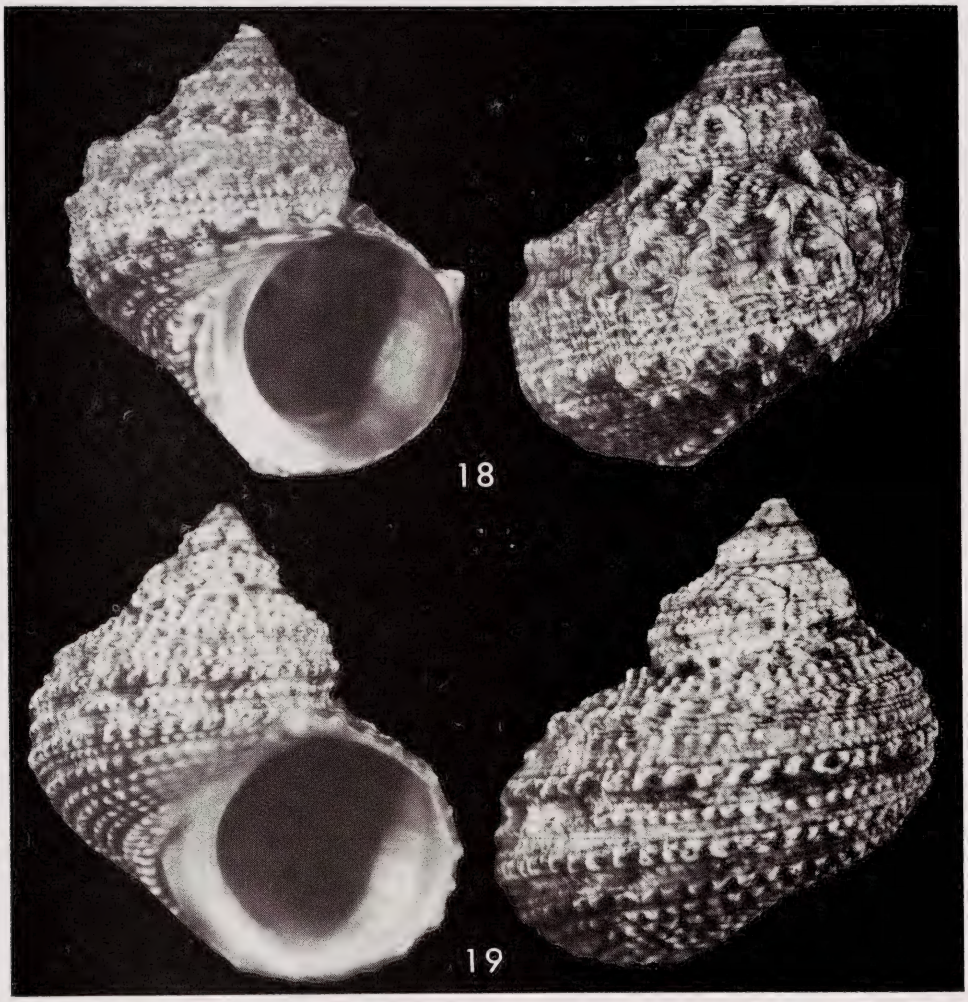
Turbo sparverius Gmelin, 1791 (Fig. 17)

1781. *"Sparverius sive nisus"* Chemnitz, Syst. Conch. Cab., 5: 204, pl. 181, fig. 1798 (East Indies) [*non binom.*]

1791. *Turbo sparverius* Gmelin, Syst. Nat., ed. 13, p. 3594 (refers to Chemnitz, *op. cit.*, fig. 1798) [India].

Dimensions of holotype: 55.7 x 44.0 mm; shell with 7 cords on the penultimate and 21 cords on the body whorl, 5th or 6th presutural cord on body whorl prominent.

The species lives in the tropical Indo-Pacific.



Figs. 18, 19. 18. Holotype of *Turbo moltkianus* Gmelin; length 41.7 mm. 19. Holotype of *T. crenulatus* Gmelin; length 30.3 mm.

Turbo moltkianus Gmelin, 1791 (Fig. 18)

1781. *"Cochlea lunaris moltkiana"* Chemnitz, Syst. Conch. Cab., 5: 205, pl. 181, figs. 1799-1800 (Hab:?) [*non binom.*]

1791. *Turbo moltkianus* Gmelin, Syst. Nat., ed. 13, p. 3595 (refers to Chemnitz, *op. cit.*, figs. 1799-1800) [Hab:?].

1798. *Lunatica tuberculata* Röding, Mus. Bolten., p. 102 (refers to Chemnitz, *op. cit.*, figs. 1799-1800).

Dimensions of holotype: 41.7 x 38.7 mm; shell with 9 granulose cords on the penultimate and *c.* 30 on the body whorl.

There are 2 smaller specimens in the container with the type-specimen, but these are clearly later additions. At the time of description, Chemnitz (*op. cit*) stated that

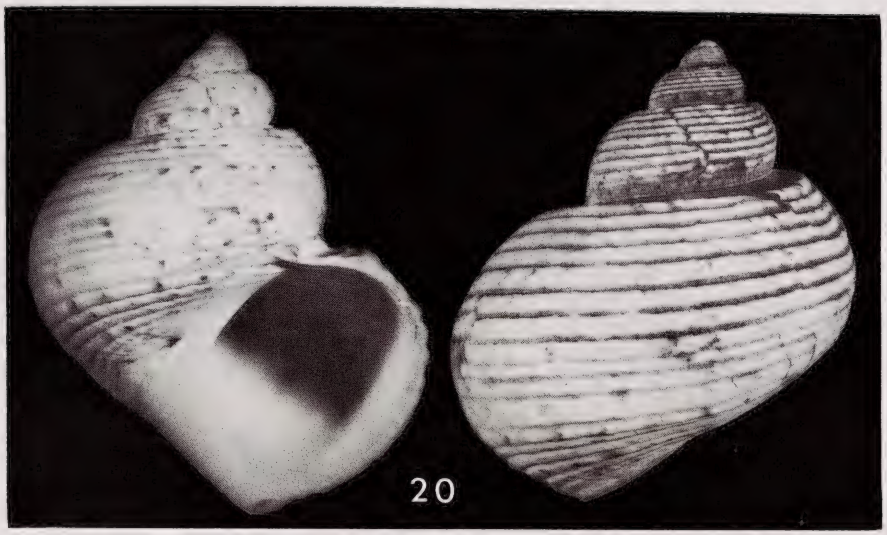


Fig. 20. Holotype of *Turbo spenglerianus* Gmelin; length 46.8 mm.

only a single specimen was known, and this was purchased for over 35 guilders at the Homoet auction in 1757 in Amsterdam, by Count Moltke.

Turbo moltkianus is very similar to *T. saxosus* Wood, 1828, from the west coast of America, and according to Pilsbry in Tryon (1888) the species lives on the west coast of Mexico.

Turbo crenulatus Gmelin, 1791 (Fig. 19)

1781. *"Cochlea lunaris crenulata"* Chemnitz, Syst. Conch. Cab., 5: 212, pl. 182, figs. 1811-12 (probably West Indies) [*non binom.*]

1791. *Turbo castanea* Gmelin, Syst. Nat., ed. 13, p. 3595 (American Seas).

1791. *Turbo crenulatus* Gmelin, *ibid.*, p. 3595 (refers to Chemnitz, *op. cit.*, figs. 1811-12) [Hab:?].

1798. *Lunatica granulata* Röding, Mus. Bolten., p. 102 (refers to Chemnitz, *op. cit.*, figs. 1811-12) [*non Turbo granulatus* Gmelin, 1791].

Dimensions of probable holotype: 30.3 x 28.0 mm; shell with 9 crenulate cords on the penultimate and 23 cords on the body whorl.

The species lives in the Caribbean and according to Warmke & Abbott (1961) is a synonym of *Turbo castanea* Gmelin, 1791.

Turbo spenglerianus Gmelin, 1791 (Fig. 20)

1781. *Turbo canaliculatus* Hermann, Naturforscher, 16: 52.

1781. *"Cochlea lunaris spengleriana"* Chemnitz, Syst. Conch. Cab., ': 206, pl. 181, figs. 1801-02 (Oriental Seas = error) [*non binom.*]

1791. *Turbo spenglerianus* Gmelin, Syst. Nat., ed. 13, p. 3595 (refers to Chemnitz, *op. cit.*, figs. 1801-02) [Indian Ocean = error].

1817. *Turbo spengleri* Schumacher, Ess. nouv. syst., p. 198 (refers to Chemnitz, *op. cit.*, figs. 1801-02).

Dimensions of holotype: 46.8 x 39.1 mm; shell with 10 spiral cords on the penultimate and 18 cords on the body whorl, sutures broad and concave, spiral cords maculated with orange and brown.

T. spenglerianus Gmelin, 1791, is a synonym of *T. canaliculatus* Hermann, 1781, from the Caribbean.

Turbo (Lunella) coronatus Gmelin, 1791 (Fig. 21)

1781. *"Corona reclusa"* Chemnitz, Syst. Conch. Cab., 5: 201, pl. 180, figs. 1791-92 (Straits of Malacca and Nicobar Ids.) [*non binom.*]

1791. *Turbo coronatus* Gmelin, Syst. Nat., ed. 13, p. 3594 (refers to Chemnitz, *op. cit.*, figs. 1791-92 [Malacca].

1798. *Lunella viridana* Röding, Mus. Bolten., p. 103 (refers to Chemnitz, *op. cit.*, figs. 1791-93).

Dimensions of holotype (Chemnitz figures 1791-92): 41.0 x 45.8 mm; shell with 4 rows of knobbly spines and 3 rows of corrugated basal cords on the body whorl, and 1 large nodulose cord adjoining concave and smooth columella.

The species lives in the China Seas and the Indian Ocean.

Turbo (Lunella) granulatus Gmelin, 1791 (Figs. 22, 23)

1781. *"Cochlea lunaris perforata"* Chemnitz, Syst. Conch. Cab., 5: 164, pl. 176, figs. 1744-46 (Nicobar Ids., and coasts of southern continents) [*non binom.*]

1791. *Turbo granulatus* Gmelin, Syst. Nat., ed. 13, p. 3601 (refers to Chemnitz, *op. cit.*, figs. 1744-45) [Indian and Southern Oceans].

1791. *Turbo granulatus* var. b Gmelin, Syst. Nat., ed. 13, p. 3601 (refers to Chemnitz, *op. cit.*, fig. 1746).

1798. *Lunella moniliformis* Röding, Mus. Bolten., p. 104 (refers to Chemnitz, *op. cit.*, fig. 1746).

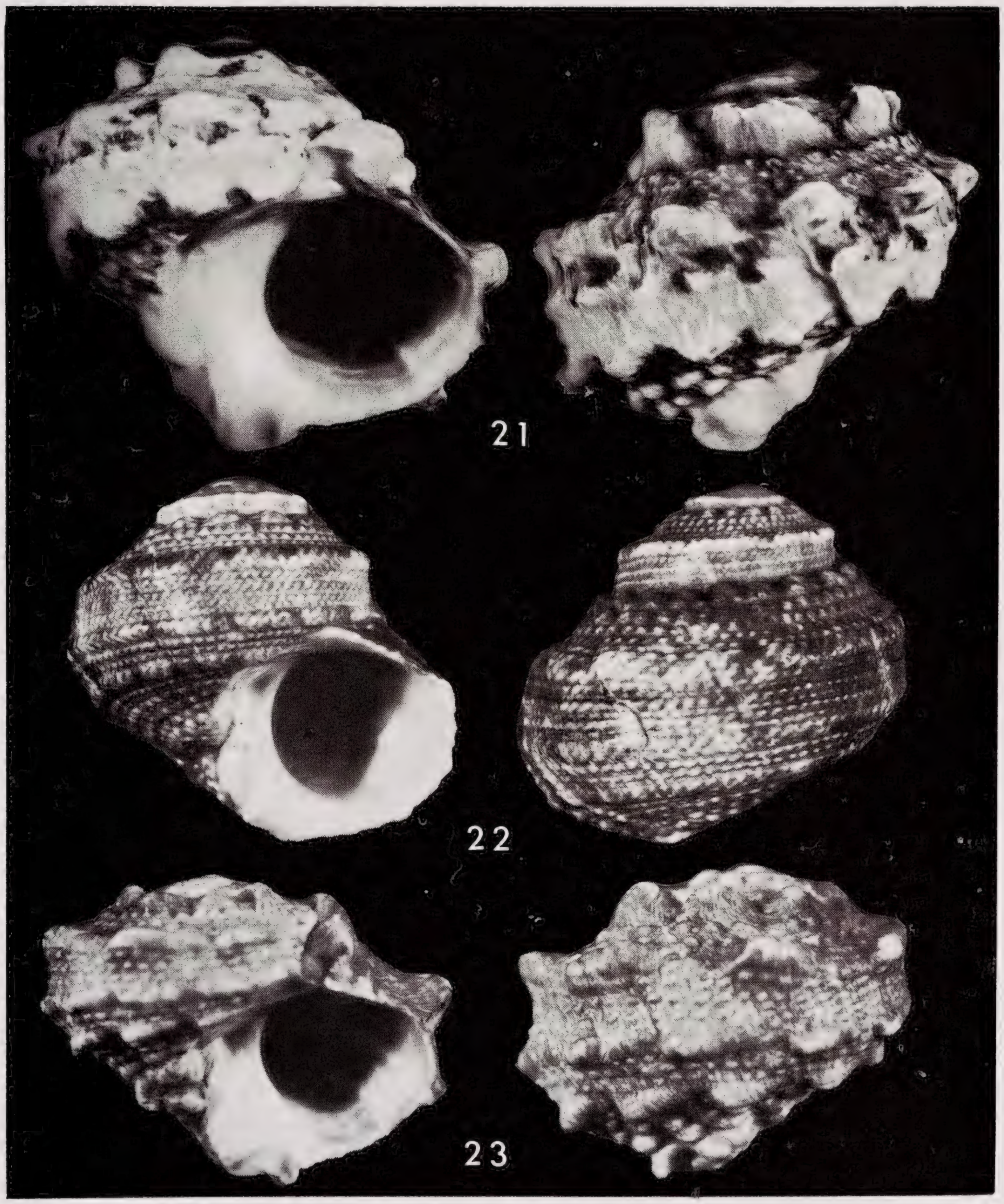
Dimensions of holotype of *T. granulatus* (Chemnitz figs. 1744-45): 34.0 x 37.4 mm; syntype of *Lunella moniliformis* (Chemnitz fig. 1746): 15.0 x 19.7 mm (young specimen) (Fig. 23).

The species is very similar to *Turbo coronatus* Gmelin, except that *T. granulatus* has a perforate umbilicus. Kuroda & Habe (Kuroda, Habe & Oyama, 1971) consider the species conspecific with *T. coronatus* Gmelin. The specimen illustrated by Chemnitz (*op. cit.*) in fig. 1746, is a young individual of *T. granulatus*. The species lives in Sino-Japanese waters and the Indian Ocean.

Subninella undulata (Gmelin, 1791) (Fig. 24)

1786. *Turbo undulatus* Lightfoot, Portland Catalogue, p. 18.

1788. *"Turbo undulatus"* Chemnitz, Syst. Conch. Cab., 10: 296, pl. 169, figs. 1640-41 (New Zealand = error, and New Holland) [*non binom.*]



Figs. 21-23. 21. Holotype of *Turbo coronatus* Gmelin; length 41.0 mm. 22. Holotype of *T. granulatus* Gmelin; length 34.0 mm. 23. Syntype of *Lunella moniliformis* Röding; length 15.0 mm.

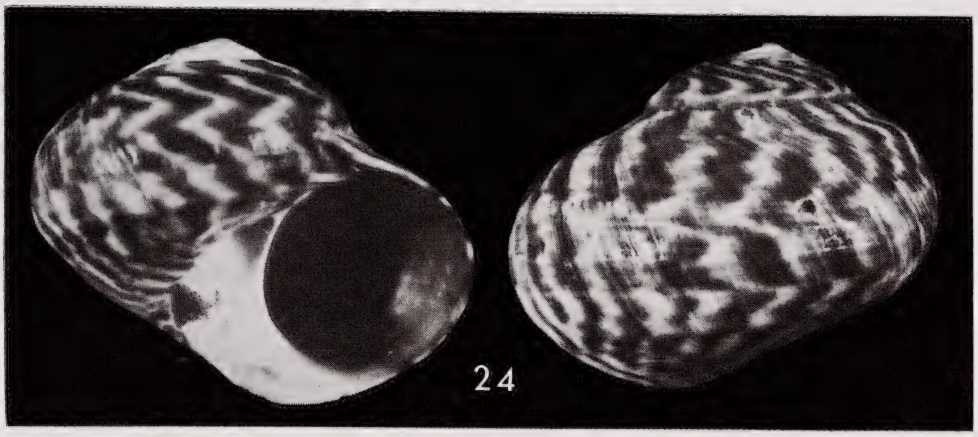


Fig. 24. Syntype of *Subninella undulata* (Gmelin); length 29.4 mm.

1791. *Turbo undulatus* Gmelin, Syst. Nat., ed. 13, p. 3597 (refers to Chemnitz, *op. cit.*, figs. 1640-41 and Martyn, 1784, Univ. Conch., pl. 1, fig. 29) [New Zealand = error, and New Holland].

Dimensions of syntype: 29.4 x 36.7 mm.

T. undulatus Gmelin, 1791, is a synonym of *T. undulatus* Lightfoot, 1786. The species lives in S.E. Australia but does not occur in New Zealand.

Family NERITIDAE

Nerita maxima Gmelin, 1791 (Fig. 25)

1781. *"Nerita maxima laevis"* Chemnitz, Syst. Conch. Cab., 5: 287, pl. 190, figs. 1942-43 (Hab:?) [*non binom.*]

1791. *Nerita maxima* Gmelin, Syst. Nat., ed. 13, p. 3683 (refers to Chemnitz, *op. cit.*, figs. 1942-43) [Hab:?].

Dimensions of holotype: 37.9 x 43.4 mm; shell smooth, with only 4-5 superficial spiral striae on shoulder, columella with 4 denticles; dark greenish-brown with cream stripes.

The species' range extends from the Philippine Islands westward into the Indian Ocean.

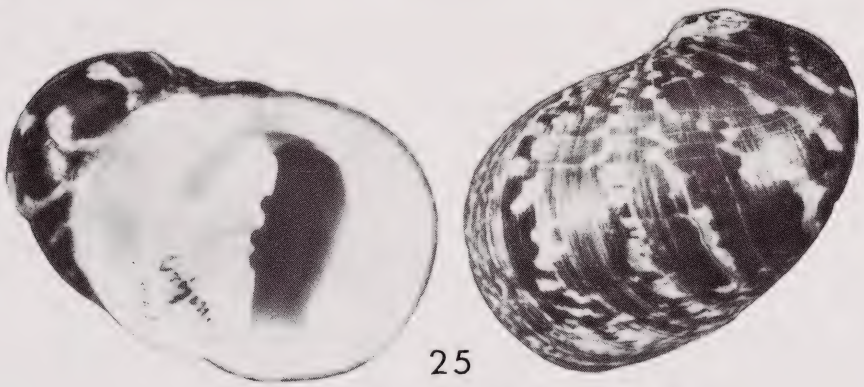
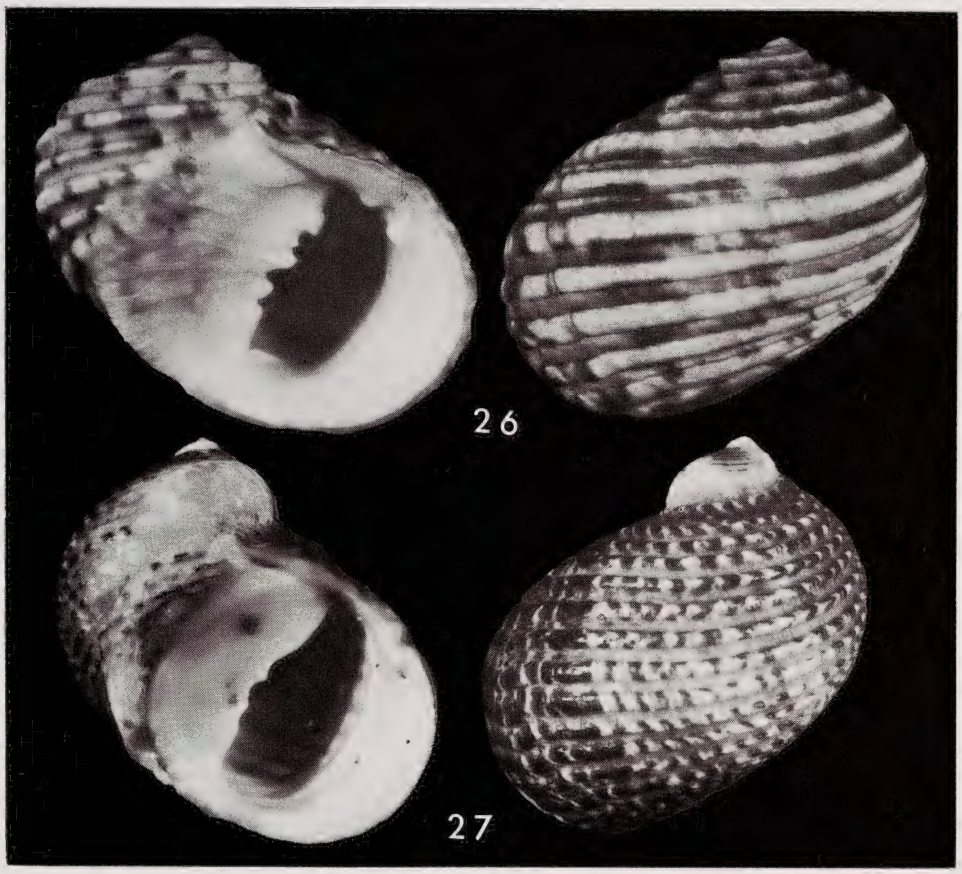


Fig. 25. Holotype of *Nerita maxima* Gmelin; length 37.9 mm.



Figs. 26, 27. 26. Syntype of *Nerita variegata* Röding; length 29.4 mm. 27. Holotype of *N. ascensionis* Gmelin; length 40.4 mm.

Nerita variegata Röding, 1798 (Fig. 26)

1758. *Nerita grossa* Linnaeus, Syst. Nat., ed. 10, p. 779 (Asiatic Ocean).

1781. *"Nerita grossa* Linnaei" Chemnitz, Syst. Conch. Cab., 5: 299, pl. 191, figs. 1968-69 (Moluccas) [*non binom.*]

1798. *Nerita variegata* Röding, Mus. Bolten., p. 18 (refers to Geve and Chemnitz, *op. cit.*, figs. 1968-69).

Dimensions of syntype: 29.4 x 32.8 mm; shell with 12 spiral cords on the body whorl, 4 denticles + 1 intercalate one on the columella, and 2 large denticles + 15 smaller ones on the outer lip; the spiral cords have greenish-brown axial bands and the columella is stained with orange.

Nerita variegata Röding, 1798, is a synonym of the Indo-Pacific *N. grossa* Linnaeus, 1758.

Nerita ascensionis Gmelin, 1791 (Fig. 27)

1781. *"Nerita in littore . . . ascensione"* Chemnitz, Syst. Conch. Cab., 5: 297, pl. 191, figs. 1956-57 (Ascension Id.) [*non binom.*]

1791. *Nerita ascensionis* Gmelin, Syst. Nat., ed. 13, p. 3683 (refers to Chemnitz, *op. cit.*, figs. 1956-57) [Ascension Id.].

Dimensions of probable holotype: 40.4 x 38.0 mm.

The dorsal side of the type-specimen has been depicted fairly well in Chemnitz (*op. cit.*), however, from a ventral view, the spire is far more elevated in the actual specimen than is shown in the figure. The species lives in the Atlantic Ocean, ranging from Brazil to Ascension Island.

Nerita bifasciata Gmelin, 1791 (Fig. 28)

1781. *"Nerita nigra"* Chemnitz, Syst. Conch. Cab., 5: 321, pl. 193, fig. 2015 (East Indies) [*non binom.*]

1791. *Nerita bifasciata* Gmelin, Syst. Nat., ed. 13, p. 3685 (refers to Rumphius and Chemnitz, *op. cit.*, fig. 1015 = error for 2015) [India].

1798. *Nerita arriaca* Röding, Mus. Bolten., p. 18 (refers to Chemnitz, *op. cit.*, fig. 2015).

1817. *Nerita nigra* Dillwyn, Desc. cat. Rec. shells, 2: 995 (refers to Chemnitz, *op. cit.*, fig. 2015) [published in synonymy of *N. polita* Linnaeus, 1758].

1850. *Nerita polita* var. *nigrobifasciata* Récluz, J. Conchyl., 1: 282 (refers to Chemnitz, *op. cit.*, fig. 2015) [Gambier Ids.].

1852. *Odontostoma nigra* Mörch, Cat. Conchyl. Yoldi, 1: 169 (refers to Chemnitz, *op. cit.*, fig. 2015).

Dimensions of syntype: 15.0 x 18.6 mm.

The type-specimen is a small and very worn *Nerita polita* Linnaeus, 1758.

Nerita litterata Gmelin, 1791 (Fig. 29)

1781. *"Nerita hieroglyphica"* Chemnitz, Syst. Conch. Cab., 5: 322, pl. 193, fig. 2016 (Hab:?) [*non binom.*]

1791. *Nerita litterata* Gmelin, Syst. Nat., ed. 13, p. 3685 (refers to Chemnitz, *op. cit.*, fig. 2016 [India].

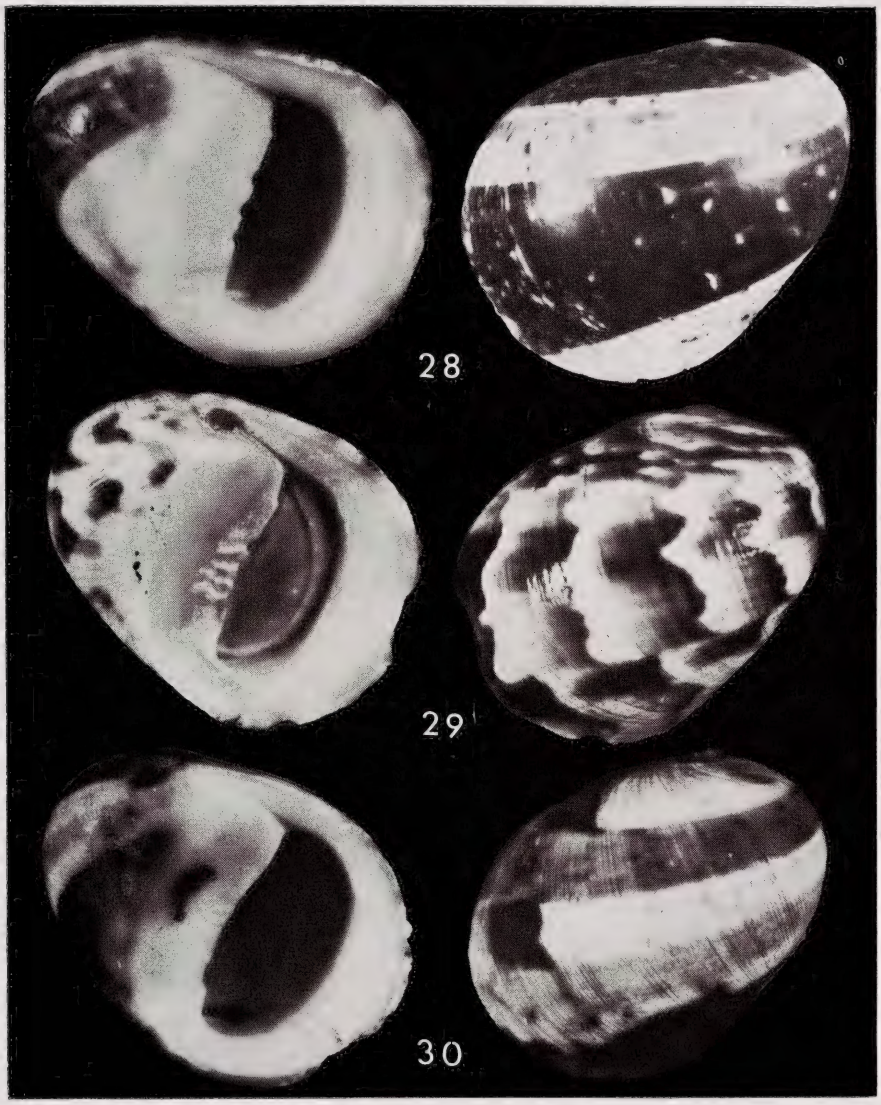
1817. *Nerita hieroglyphica* Dillwyn, Desc. cat. Rec. shells, 2: 995 (refers to Chemnitz, *op. cit.*, fig. 2016) [East Indian Seas].

1850. *Nerita hyerogliphica* Récluz, J. Conchyl., 1: 282 (refers to Chemnitz, *op. cit.*, fig 2016) [Fiji Ids.].

1852. *Odontostoma hieroglyphica* Mörch, Cat. Conchyl. Yoldi, 1: 168 (refers to Chemnitz, *op. cit.*, figs. 2016, 2018).

Dimensions of holotype: 15.7 x 17.0 mm; shell spirally and axially striate, columella with 4 small denticles, outer lip minutely dentate.

The type-specimen still contains the operculum. *Nerita litterata* Gmelin, 1791, is another synonym of the variable Indo-Pacific *N. polita* Linnaeus, 1758.



Figs. 28-30. 28. Syntype of *Nerita bifasciata* Gmelin; length 15.0 mm. 29. Holotype of *N. litterata* Gmelin; length 15.7 mm. 30. Syntype of *N. larva* Gmelin; length 16.5 mm.

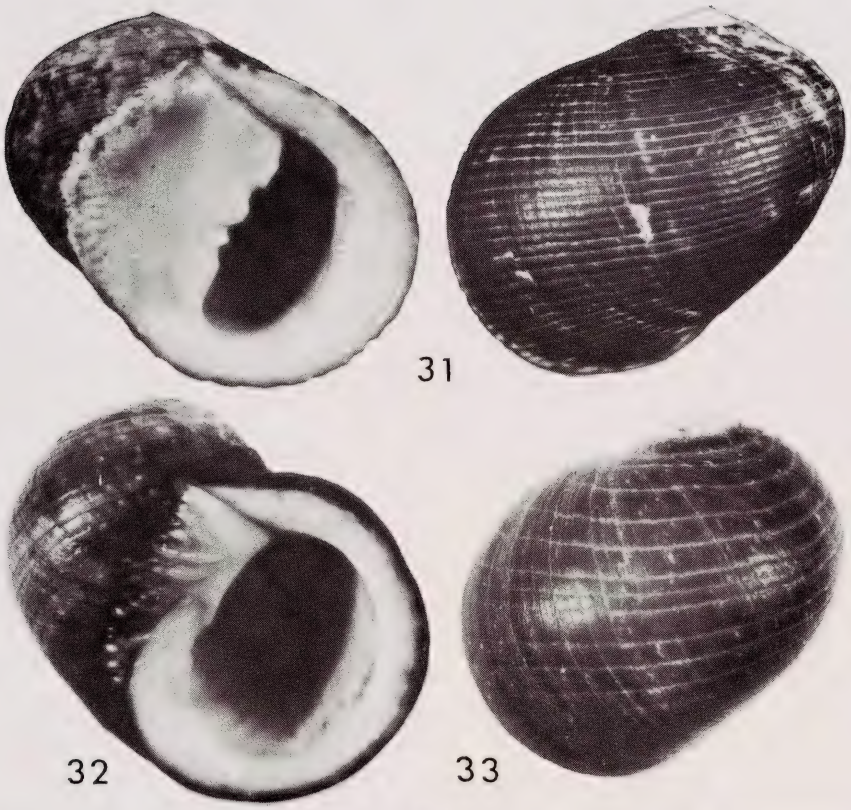
Nerita larva Gmelin, 1791 (Fig. 30)

1781. *"Nerita larva"* Chemnitz, Syst. Conch. Cab., 5: 323, pl. 193, fig. 2017 (Amboina) [*non binom.*]

1791. *Nerita larva* Gmelin, Syst. Nat., ed. 13, p. 3679 (refers to Rumphuis, pl. 22, fig. 6 and Chemnitz, *op. cit.*, fig. 2017) [Amboina].

Dimensions of syntype: 16.5 x 19.0 mm; shell axially finely striate, columella with 9 irregular small denticles.

The type-specimen is an immature individual of the Indo-Pacific *Nerita polita* Linnaeus, 1758.



Figs. 31-33. 31. Syntype of *Nerita nigrita* Röding; length 32.4 mm. 32, 33. Syntypes of *N. aterrima* Gmelin. 32. Length 27.5 mm. 33. Length 23.2 mm.

Nerita nigrita Röding, 1798 (Fig. 31)

1758. *Nerita histrio* Linnaeus, Syst. Nat., ed. 10, p. 778 (Hab:?)

1781. *"Nerita ex nigro"* Chemnitz, Syst. Conch. Cab., 5: 291, pl. 190, figs. 1948-49 and pl. 191, figs. 1960-61 (East Indies) [*non binom.*]

1798. *Nerita nigrita* Röding, Mus. Bolten., p. 19 (refers to Chemnitz, *op. cit.*, figs. 1960-61).

1850. *Nerita chemnitzii* Récluz, J. Conchyl., 1: 284 (refers to Chemnitz, *op. cit.,* figs. 1960-61) [Port du R. George].

Dimensions of syntype (Chemnitz figs. 1960-61): 32.4 x 35.4 mm; shell with 35 spiral cords on the body whorl, columella with 4 denticles and 3 weak plicae, outer lip with 22 small denticles.

The species appears to be conspecific with the Indian Ocean *Nerita histrio* Linnaeus, 1758.

Nerita aterrima Gmelin, 1791 (Figs. 32, 33)

1781. *"Nerita nigerrima"* Chemnitz, Syst. Conch. Cab., 5: 309, pl. 192, figs. 1985-86 (Hab:?) [*non binom.*]

1791. *Nerita aterrima* Gmelin, Syst. Nat., ed. 13, p. 3679 (refers to Chemnitz, *op. cit.*, figs. 1985-86) [Hab:?].

1817. *Nerita nigerrima* Dillwyn, Desc. cat. Rec. shells, 2: 996 (refers to Chemnitz, *op. cit.*, figs. 1985-86) [Hab:?].

Dimensions of 2 probable syntypes: 27.5 x 27.0 mm and 23.2 x 24.2 mm; shell with *c.* 16 spiral grooves on the body whorl, narrow columellar callus slightly plicate and with 1 denticle and 2 small, feeble nodules, aperture wide, outer lip with 2 larger and 3-4 smaller denticles.

We have been unable to elucidate the identity of this species. Mörch (1852) cited "Antilles" as the locality for *N. aterrima,* but he probably confused the species with *N. fulgurans* Gmelin, 1791. Reeve (1855) and all subsequent authors, illustrate a completely different species for the *"N. nigerrima"* of Chemnitz. On the label accompanying the type-specimen, someone added the locality "Coasts of Guinea". It is probable that *N. aterrima* is only an unusual variant of *N. senegalensis* Gmelin, 1791.

Nerita undulata Gmelin, 1791 (Fig. 34)

1758. *Nerita chamaeleon* Linnaeus, Syst. Nat., ed. 10, p. 779 (Banda Id. = Moluccas, Indonesia).

1781. *"Nerita undata subtilior"* Chemnitz, Syst. Conch. Cab., 5: 301, pl. 191, figs. 1970-71 (East Indies) [*non binom.*]

1791. *Nerita undulata* Gmelin, Syst. Nat., ed. 13, p. 3678 (refers to Chemnitz, *op. cit.*, figs. 1970-71) [India].

Dimensions of holotype: 21.7 x 24.0 mm; shell with *c.* 30 spiral threads on the body whorl, 7 weak plicae on the columella, denticles only indicated by a swelling, outer lip with 15 small denticles; light green in colour, with blackish-brown zones.

N. undulata Gmelin, 1791, is a synonym of the Indo-Pacific species *N. chamaeleon* Linnaeus, 1758.

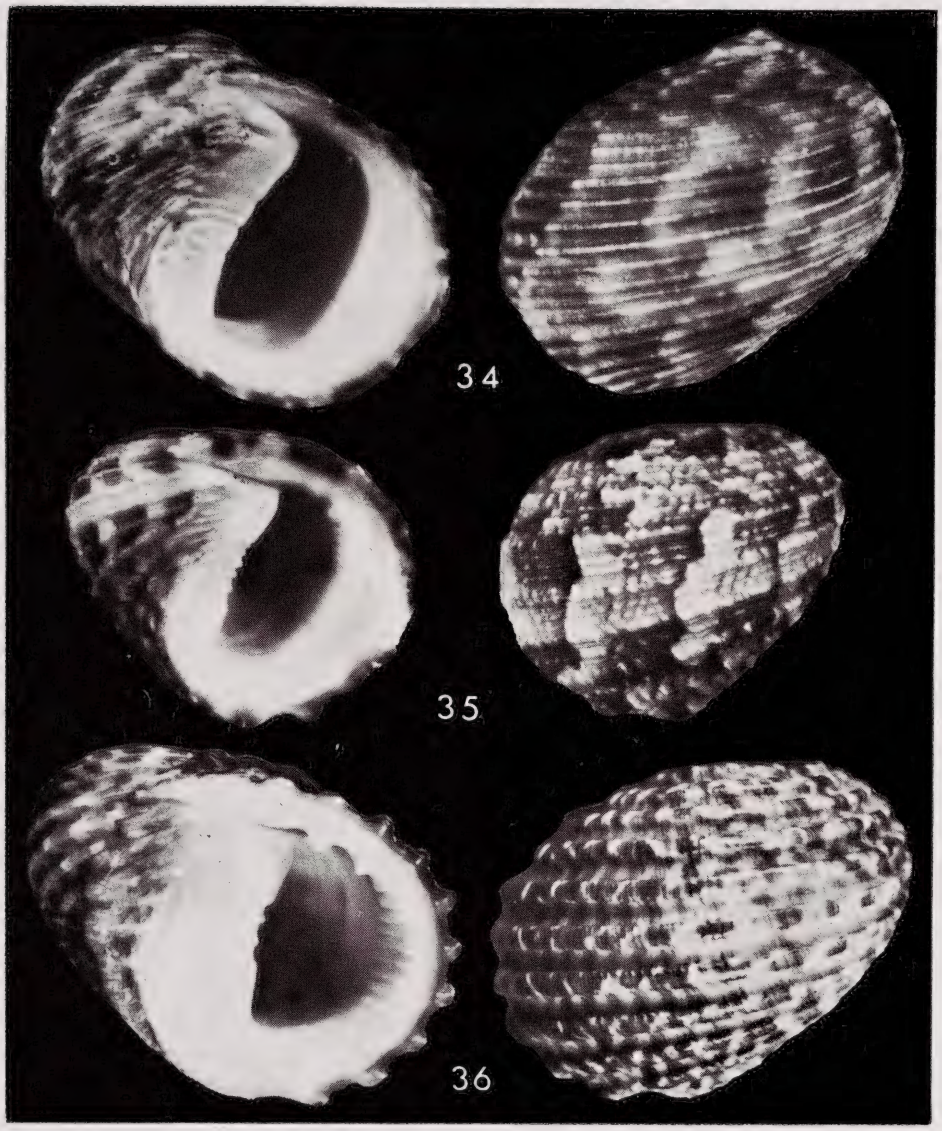
Nerita stella Dillwyn, 1817 (Fig. 35)

1795. *"Nerita stella"* Chemnitz, Syst. Conch. Cab., 11: 174, pl. 197, figs. 1907-08 (East Indies) [*non binom.*]

1817. *Nerita stella* Dillwyn, Desc. cat. Rec. shells, 2: 1004 (refers to Chemnitz, *op. cit.*, figs. 1907-08) [East Indian Seas].

Dimensions of syntype (ex-Spengler coll.): 16.5 x 18.7 mm; shell with a depressed spire, 27 strong or weak spiral cords on the body whorl, 5 small denticles on the columella, a wrinkled callus and a finely dentate outer lip.

Chemnitz (*op. cit.*) based his description of the species on a specimen from the Danish Natural History Society and another from the Spengler collection. The extant Spengler specimen is a variant of *N. chamaeleon* Linnaeus, 1758, with a depressed spire and coarser, more granulose sculpture, and has subsequently been described as *N. squamulata* Le Guillou, 1841. *N. stella* Dillwyn, is similar to *N. planospira* Anton, 1839 (synonym *N. atropurpurea* Récluz, 1841), but the latter species is easily distinguished by the presence of an elongated, purple-black blotch adjacent to the columella



Figs. 34-36. 34. Holotype of *Nerita undulata* Gmelin; length 21.7 mm. 35. Syntype of *N. stella* Dillwyn; length 16.5 mm. 36. *N. exuvia* Linnaeus (specimen from Chemnitz, figs. 1972-73); length 22.0 mm.

and the unusual twist of the outer lip over the spire. *N. exuvia* Linnaeus, 1758, has similar apertural features, but this species has elevated, thick and broad spiral cords with deep and concave interspaces. A specimen of *N. exuvia* illustrated by Chemnitz (Martini & Chemnitz 1781, vol. 5, figs. 1972-73) is shown for comparison (Fig. 36).

Nerita pica Gmelin, 1791 (Fig. 37)

1781. *"Pica in familia neritarium imperforatum"* Chemnitz, Syst. Conch. Cab., 5: 298, pl. 191, figs. 1964-65 (Hab:?) [*non binom.*]

Fig. 37. Syntype of *Nerita pica* Gmelin; length 24.5 mm.

1791. *Nerita pica* Gmelin, Syst. Nat., ed. 13, p. 3684 (refers to Rumphius, pl.22, fig. 4 and Chemnitz, *op. cit.*, figs. 1964-65) [Indian Ocean = error].

1791. *Nerita versicolor* Gmelin, Syst. Nat., ed. 13, p. 3684 (Antilles).

1798. *Nerita tessellata* (Röding, Mus. Bolten., p. 19 (refers to Chemnitz, *op. cit.*, figs. 1964-65) [*non* Gmelin, 1791].

Dimensions of syntype: 24.5 x 25.7 mm; shell white, maculated with black, sculptured with 17 strong, black-spotted cords on body whorl, columella with 4 denticles, outer lip with 13.

Chemnitz (*op. cit.*) was ignorant of the species locality, but Gmelin (1791) suggested the Indian Ocean. The locality indication is incorrect, and *N. pica* Gmelin is a synonym of the Caribbean *N. versicolor* Gmelin, 1791.

Family NATICIDAE

Natica undulata (Röding, 1798) (Fig. 38)

1781. *"Zebra in familia neritarum"* Chemnitz, Syst. Conch. Cab., 5: 263, pl. 187, figs 1885-86 (Moluccas) [*non binom.*]

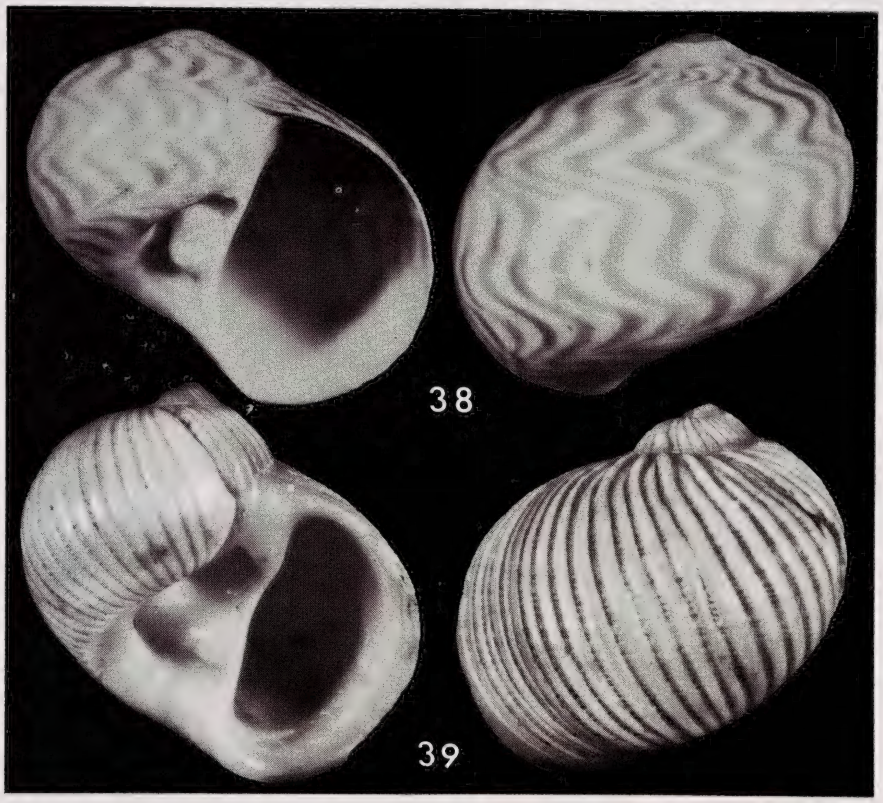
1798. *Cochlis undulata* Röding, Mus. Bolten., p. 147 (refers to Chemnitz, *op. cit.*, figs. 1885-86).

1817. *Nerita zebra* Dillwyn, Desc. cat. Rec. shells, 2: 977 (refers to Chemnitz, *op. cit.*, figs. 1885-86 [published in synonymy of *Nerita canrena* Linnaeus, var. I].

1822. *Natica zebra* Lamarck, Hist. nat. anim. s. vert., 6: 203.

Dimensions of syntype: 20.8 x 23.6 mm; shell only weakly striated at sutures, cream in colour, with wavy orange-brown flames, protoconch purple.

The species lives in the tropical West Pacific and the Indian Ocean. *Natica zebra* Lamarck, 1822, is a synonym.



Figs. 38, 39. 38. Syntype of *Natica undulata* (Röding); length 20.8 mm. 39. Holotype of *N. rugosa* (Gmelin); length 20.8 mm.

Natica rugosa (Gmelin, 1791) (Fig. 39)

1778. *Nerita sulcata* Born, Ind. rer. nat. mus. Caes. Vindob., p. 416, 1780 Born, Test. Mus. Caes. Vindob., p. 400, pl. 17, figs. 5, 6 (Hab:?).

1781. *"Nerita rugosa"* Chemnitz, Syst. Conch. Cab., 5: 269, pl. 188, figs. 1902-03 (West Indies) [*non binom.*]

1791. *Nerita rugosa* Gmelin, Syst. Nat., ed. 13, p. 3673 (refers to Chemnitz, *op. cit.*, figs. 1902-03) [American Islands].

1798. *Cochlis plicata* Röding, Mus. Bolten., p. 147 (refers to Chemnitz, *op. cit.*, figs. 1902-03).

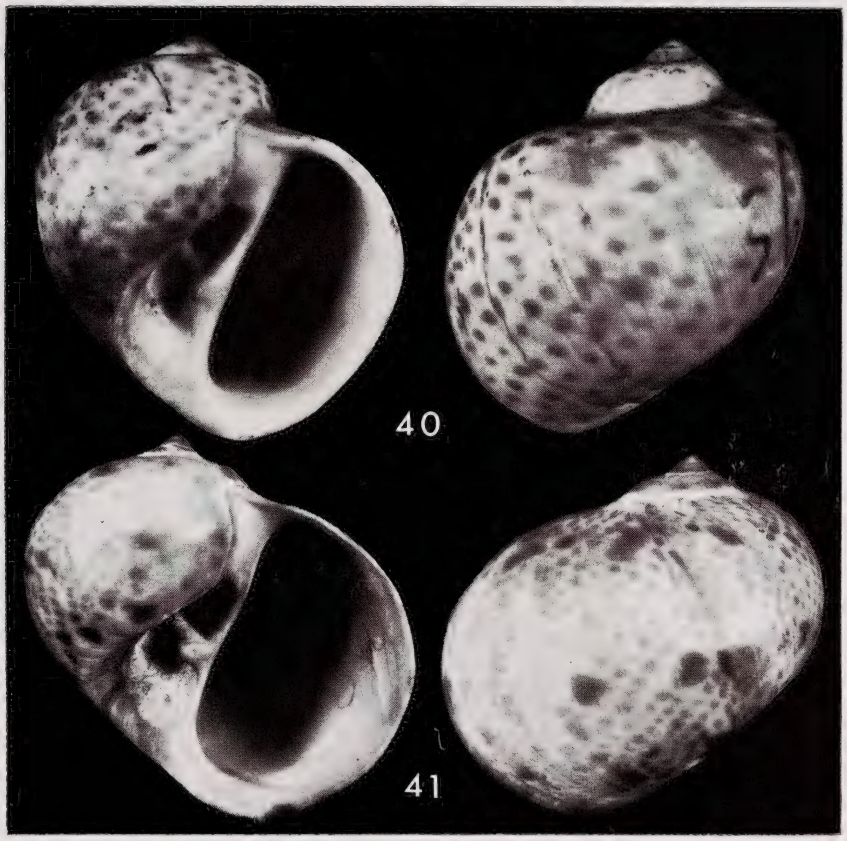
Dimensions of holotype: 20.8 x 20.9 mm; shell with 37 axial ribs on the body whorl and pitted interspaces.

Nerita rugosa Gmelin, 1791, is a synonym of *Natica sulcata* (Born, 1778), from the West Indies.

Natica stercusmuscarum (Röding, 1798) (Figs. 40, 41)

1781. *"Nerita multoties punctata"* Chemnitz, Syst. Conch. Cab., 5: 261, pl. 187, figs. 1878-80 (East Indies = error) [*non binom.*]

1791. *Nerita cruentata* Gmelin, Syst. Nat., ed. 13, p. 3673 (refers to Chemnitz, vol. 5, pl. 188, figs. 1900-01) [Hab:?].



Figs. 40, 41. Syntypes of *Natica stercusmuscarum* (Röding). 40. Specimen illustrated by Chemnitz, figs. 1878-79; length 23.7 mm. 41. Specimen illustrated by Chemnitz, fig. 1880; length 22.2 mm.

1798. *Cochlis stercusmuscarum* Röding, Mus. Bolten., p. 147 (refers to Chemnitz, *op. cit.*, figs. 1878-80) [*non Nerita stercusmuscarum* Gmelin, 1791 = *Natica*].

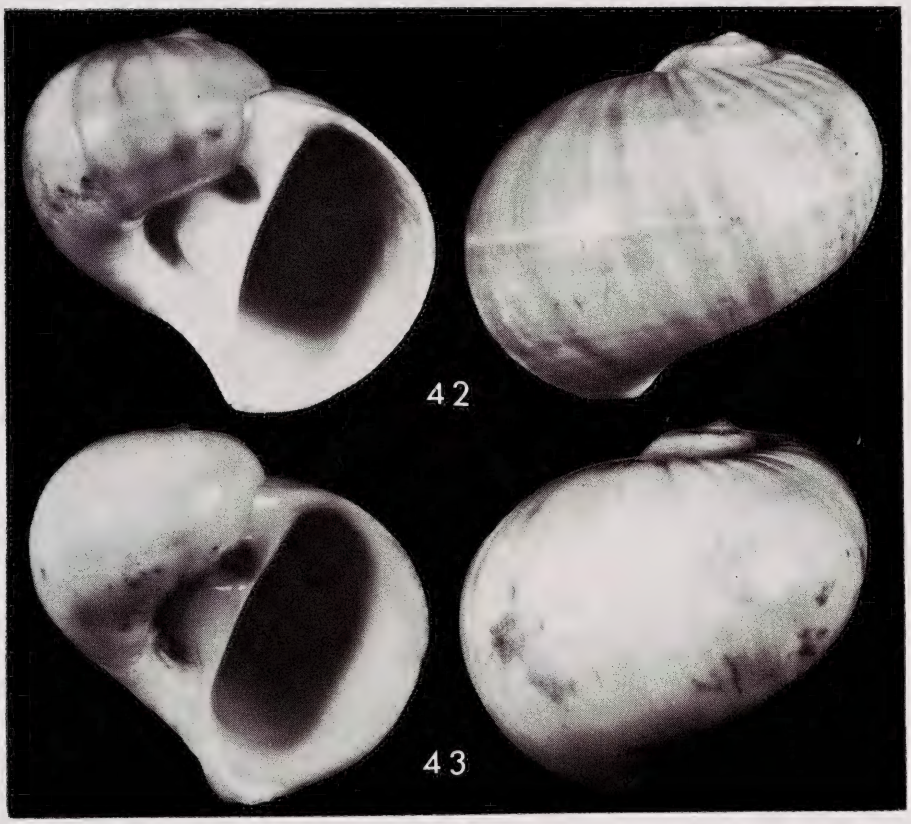
1829. *Natica adspersa* Menke, Verz. Conchyl.-Samml. Malsburg, p. 13; 1830 Menke, Synop. meth. Mollusc., p. 46 (refers to Chemnitz, *op. cit.*, figs. 1676-1680 = error for figs. 1876-80).

1838. *Natica maculata* Deshayes in Deshayes & Edwards, Hist. nat. anim. s. vert., ed. 2, 8: 645 (refers to Chemnitz, *op. cit.*, figs. 1878-80, Gualtieri and Schröter) [Mediterranean] (non *Natica maculata* Perry, 1811).

1852. *Natica (Cochlis) multoties punctata* Mörch, Cat. Conchyl. Yoldi, 1: 134 (refers to Chemnitz, *op. cit.*, figs. 1878-80).

Dimensions of syntype (Chemnitz figs. 1878-79): 23.7 x 22.2 mm; shell with a row of large brown spots near suture; syntype (Chemnitz fig. 1880): 22.2 x 23.2 mm; shell with 3 rows of large brown spots on the body whorl.

The species lives in the Mediterranean and is a synonym of *Natica cruentata* (Gmelin, 1791).



Figs. 42, 43. 42. Holotype of *Natica orientalis* (Gmelin); length 27.0 mm. 43. Syntype of *N. explanata* (Röding); length 28.4 mm.

Natica orientalis (Gmelin, 1791) (Fig. 42)

1781. *"Nerita subfulva"* Chemnitz, Syst. Conch. Cab., 5: 268, pl. 188, figs. 1898-99 (Oriental Seas) [*non binom.*]

1791. *Nerita orientalis* Gmelin, Syst. Nat., ed. 13, p. 3673 (refers to Chemnitz, *op. cit.*, figs. 1898-99) [Oriental Seas].

1798. *Albula vitellus* Röding, Mus. Bolten., p. 20 (refers to Chemnitz, *op. cit.*, figs. 1898-99) [*non Nerita vitellus* Linnaeus, 1758 = *Natica*].

1817. *Nerita subfulva* Dillwyn, Desc. cat. Rec. shells, 2: 982 (refers to Chemnitz, *op. cit.*, figs. 1898-99) [published in synonymy of *N. orientalis* Gmelin, 1791].

Dimensions of holotype: 27.0 x 29.0 mm; shell smooth and only weakly crenulate near sutures.

The species lives in the Indian Ocean.

Natica explanata (Röding, 1798) (Fig. 43)

1781. *"Nerita eburnea candidissima"* Chemnitz, Syst. Conch. Cab., 5: 268, pl. 188, fig. 1904 (Oriental Seas) [*non binom.*]

1791. *"Nerita orientalis"* var. b Gmelin, Syst. Nat., ed. 13, p. 3673 (refers to Chemnitz, *op. cit.*, fig. 1904 (Oriental Seas).

1798. *Cochlis explanata* Röding, Mus. Bolten., p. 146 (refers to Chemnitz, *op. cit.*, fig. 1904).

1817. *Nerita eburnea* Dillwyn, Des. cat. Rec. shells, 2: 982 (refers to Chemnitz, *op. cit.*, fig. 1904) [published in synonymy of *Nerita orientalis* var. b Gmelin, 1791].

1838. *Natica eburnea* Deshayes & Edwards, Hist. nat. anim. s. vert., ed. 2, 8: 646 (refers to Chemnitz, *op. cit.*, fig. 1904 and Geve, pl. 28, fig. 308) [*non* Cristofori & Jan, 1832].

Dimensions of syntype: 28.4 x 30.0 mm.

The type-specimen is an albinotic individual of *Natica orientalis* (Gmelin, 1791). There are still traces of brown on the shell and within the aperture.

Polinices tumidus (Swainson, 1840) (Fig. 44)

— *Polinices mamilla auct. (non Nerita mamilla* Linnaeus, 1758).

1781. *"Mamma albula"* Chemnitz, Syst. Conch. Cab., 5: 280, pl. 189, figs. 1928-31 (East Indies and Tranquebar) [*non binom.*]

1798. *Albula mammilla* Röding, Mus. Bolten., p. 20 (refers to Chemnitz, *op. cit.*, figs. 1928-31) [*non Nerita mamilla* Linnaeus, 1758].

1840. *Mamillaria tumida* Swainson, Treat. Malac., p. 345 (refers to Chemnitz, *op. cit.*, figs. 1928-31).

Only the syntype illustrated by Chemnitz (*op. cit.*) in figures 1928-29 remains in the Spengler collection. This syntype is the common Indo-Pacific *"Polinices mamilla"* of authors (not of Linnaeus, 1758), and *Natica pyriformis* Récluz, 1844. In order to stabilise nomenclature, the remaining syntype, dimensions 43.2 x 33.3 mm, is here designated as the lectotype of *Mamillaria tumida* Swainson, 1840. For further discussions on this species and *Polinices mamilla* (Linnaeus), see Cernohorsky (1971).

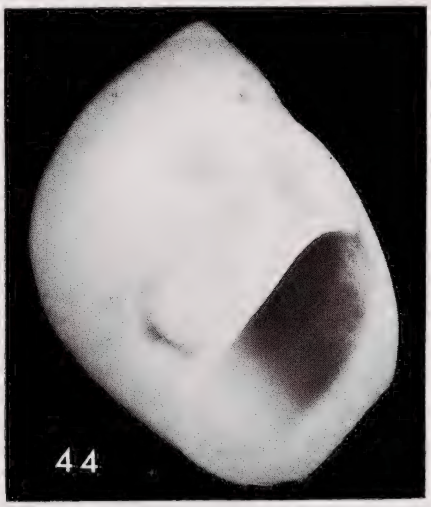


Fig. 44. Lectotype of *Polinices tumidus* (Swainson); length 43.2 mm.

Fig. 45. Syntype of *Cymatium tripus* (Lamarck); length 75.4 mm.

Family CYMATIIDAE

Cymatium tripus (Lamarck, 1822) (Fig. 45)

1795. *"Murex tripus"* Chemnitz, Syst. Conch. Cab., 11: 128, pl. 193, figs. 1858-59 (Tutucoryn, near Cabo Comorin, Coromandel) [*non binom.*]

1817. *Murex tripus* Dillwyn, Desc. cat. Rec. shells, 2: 697 (refers to Chemnitz, *op. cit.*, figs. 1858-59 with a query) [published in synonymy of *M. femorale* Linnaeus, var.].

1822. *Triton tripus* Lamarck, Hist. nat. anim. s. vert., 7: 184 (refers to Chemnitz, *op. cit.*, figs. 1858-59).

Dimensions of 2 syntypes: 75.4 x 37.3 mm and 7.3 x 34.3 mm.

Lamarck owned his own specimens of *Triton tripus,* and the Chemnitz specimen would qualify for type selection only if Lamarck's types could no longer be found.

Family MURICIDAE

Pterynotus alatus (Röding, 1798) (Fig. 46)

1777. *"Purpura subulata triquetra"* Martini, Syst. Conch. Cab., 3: 350, pl. 111, figs. 1036-37 (near Tranquebar, coast of Coromandel) [*non binom.*]

1798. *Purpura alata* Röding, Mus. Bolten., p. 144 (refers to Martini, *op. cit.*, figs. 1036-37).

1839. *Murex acanthopterus* Anton, Verz. Conchyl., p. 81 (refers to Martini, *op. cit.*, figs. 1036-37) [non Lamarck, 1816].

1840. *Murex martinianus* (Pfeiffer, Krit. Reg. Mart. & Chemn. syst. Konchyl. Kab., p. vii refers to Martini, *op. cit.*, figs. 1036-37).

Dimensions of syntype: 56.0 x 23.0 mm; (type-specimen ex-Spengler coll.).

Purpura alata Röding, 1798, is an earlier name for *Murex pinnatus* Swainson, 1822. The species range extends westward from the Philippine Islands.

Fig. 46. Syntype of *Pterynotus alatus* (Röding); length 56.0 mm.

Hexaplex rosarium (Röding, 1798) (Fig. 47)

1788. *"Murex rosarium"* Chemnitz, Syst. Conch. Cab., 10: 245, pl. 161, figs. 1528-29 (*non binom.*)

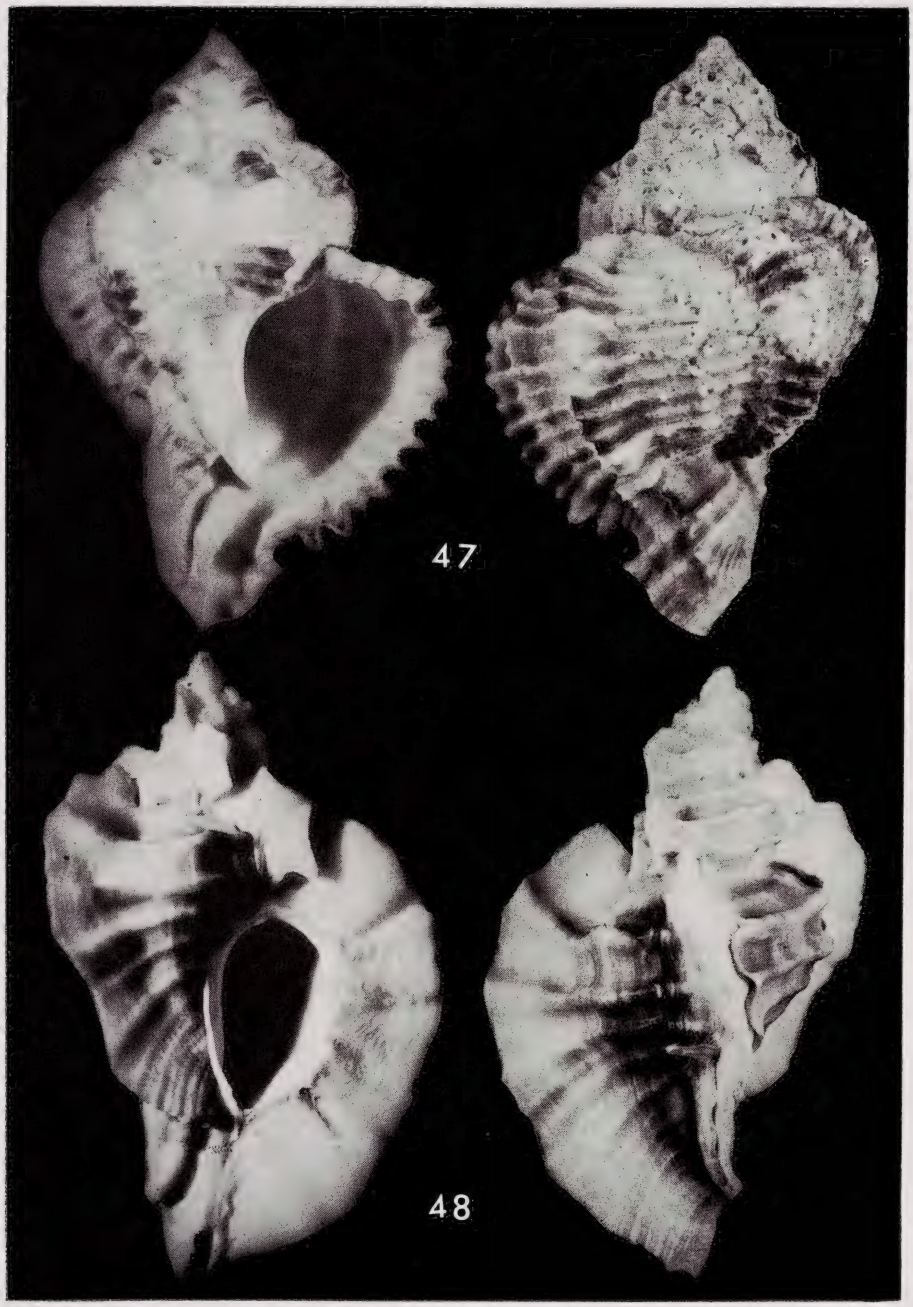
1798. *Purpura rosarium* Röding, Mus. Bolten., p. 140 (refers to Chemnitz, *op. cit.*, figs. 1528-29).

1816. *Purpura imperialis* Schumacher, Essai nouv. syst., p. 213 (refers to Chemnitz, *op. cit.*, figs. 1528-29 and Favanne, pl. 37, fig. 13).

1817. *Murex rosarium* Dillwyn, Desc. cat. Rec. shells, 2: 685 (refers to Chemnitz, *op. cit.*, figs. 1528-29).

Dimensions of syntype: 64.0 x 40.8 mm; immature specimen with 6 varices on each whorl.

The species lives in West Africa. Knudsen (1956) gives a detailed synonymy and includes *Purpura rosarium* Röding, 1798, in the synonymy of *Murex saxatilis* Linnaeus, 1758 (= *M. saxatilis* of authors — non Linnaeus). Vokes (1971), however, considers *Murex saxatilis* of authors (= *Purpura duplex* Röding, 1798) to be distinct from *P. rosarium*. The two syntypes of *Murex melonulus* Lamarck, 1822, in the Muséum d'Histoire Naturelle, Geneva, No. 1099/51, are the same species as *Purpura rosarium* Röding.



Figs. 47, 48. 47. Syntype of *Hexaplex rosarium* (Röding); length 64.0 mm. 48. Syntype of *Ceratostoma foliatum* (Gmelin); length 58.7 mm.

Ceratostoma foliatum (Gmelin, 1791) (Fig. 48)

1784. *"Purpura foliata"* Martyn, Univ. Conch., 2: pl. 66, 2 figs. (N.W. coast of America) [*non binom.*]

1788. *"Murex purpura alata"* Chemnitz, Syst. Conch. Cab., 10: 250, pl. 161, figs. 1538-39 (N.W. coast of America and King George Sound = last locality an error) [*non binom.*]

1791. *Murex foliatus* Gmelin, Syst. Nat., ed. 13, p. 3529 (refers to Martyn, *op. cit.*, pl. 66, and Chemnitz, *op. cit.*, fig. 153 = error for 1538).

1817. *Purpura alata* Schumacher, Essai nouv. syst., p. 213 (refers to Chemnitz, *op. cit.*, figs. 1538-39 [*non* Röding, 1798].

1822. *Murex tripterus* Lamarck, Hist. nat. anim. s. vert., 7: 165; 1842 Kiener, Spéc. gén. icon. coq. viv., 7: 108, pl. 26, fig. 2 (*non* Born, 1778; *nec* Lamarck, 1803 and 1816).

Dimensions of syntype: 58.7 x 35.0 mm.

The species lives in N.W. America, and Chemnitz's second locality indication of King George Sound [= outer harbour of Albany, S.W. Australia] is an error. *Murex tripterus* Lamarck, 1803 and 1816, is a fossil from Grignon, Eocene of France, which which has been re-named *M. tripteroides* Lamarck, 1822. Lamarck's 2 syntypes of *M. tripterus* of 1822, are in the Muséum d'Histoire Naturelle, Geneva, No. 1099/29, and are the same species as *M. foliatus* Gmelin, 1791.

Thais sacellum (Gmelin, 1791) (Fig. 49)

1788. *"Murex sacellum"* Chemnitz, Syst. Conch. Cab., 10: 267, pl. 163, figs. 1561-62 (Nicobar Ids.) [*non binom.*]

1791. *Murex sacellum* Gmelin, Syst. Nat., ed. 13, p. 3530 (refers to Chemnitz, *op. cit.*, figs. 1561-62) [Nicobar Ids., Indian Ocean].

1798. *Drupa muricina* Röding, Mus. Bolten., p. 56 (refers to Chemnitz, *op. cit.*, figs. 1561-62).

Dimensions of holotype: 44.6 x 34.6 mm; shell immature, spirally corded and with a single row of prominent spines on the spire whorls and 5 spinose cords on the body whorl.

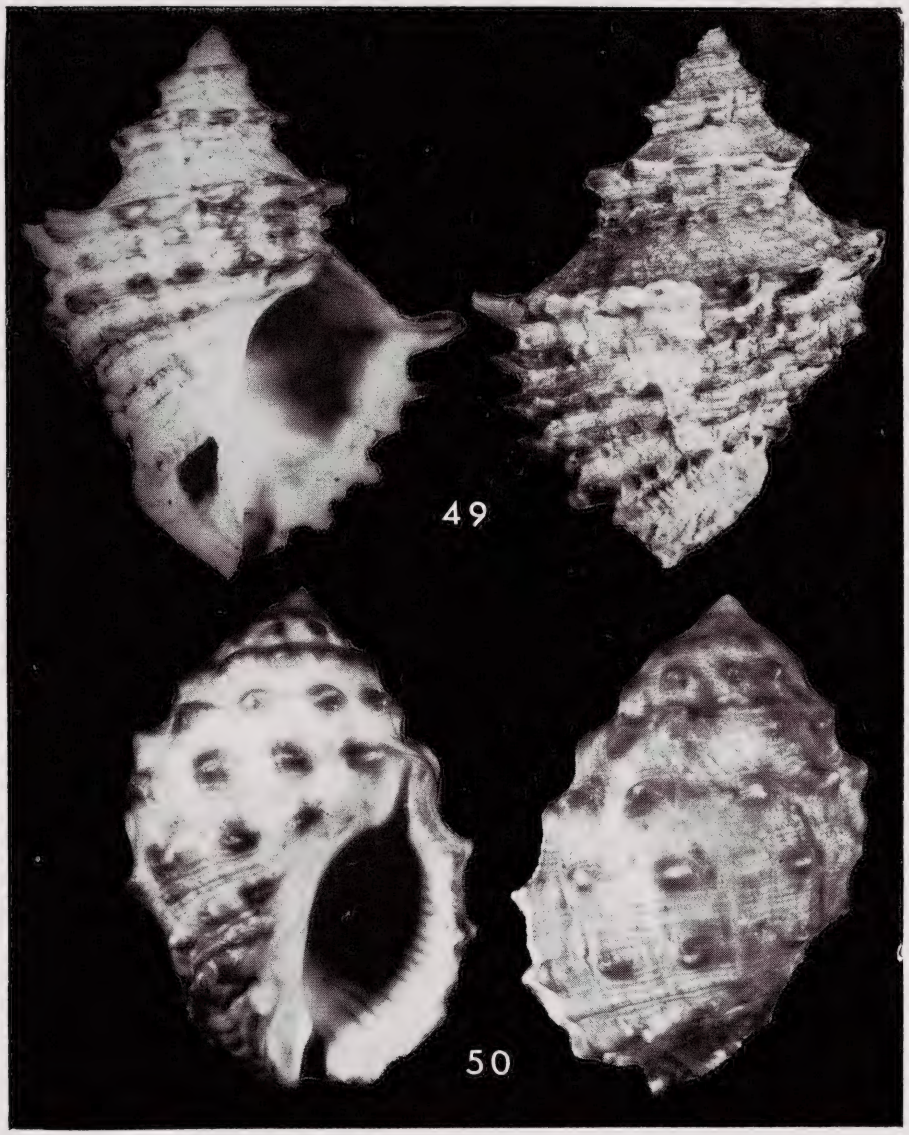
The species has been mistaken during the last century for *Murex rugosus* Born, 1778, a small moruline species which is probably referable to *Drupella* Thiele. Deshayes & Edwards (1843) remarked on the confusion surrounding *Murex sacellum*, but erroneously assigned the species to *Pyrula*. Kaicher (1957) illustrates *Thais sacellum* under the name *T. rugosa* (Born), and reports its occurrence in India, Ceylon and Malaya.

Mancinella pyrum (Dillwyn, 1817) (Fig. 50)

1795. *"Murex pyrum nodosum silvestre"* Chemnitz, Syst. Conch. Cab., 11: 122, pl. 192, figs. 1847-48 (South Seas) [*non binom.*]

1798. *Volema alouina* Röding, Mus. Bolten., p. 58 (refers to Martini, vol. 3, pl. 101, figs. 967-68).

1798. *Volema glacialis* Röding, Mus. Bolten., p. 58 (same reference as for *V. alouina* Röding, 1798).



Figs. 49, 50. 49. Holotype of *Thais sacellum* (Gmelin); length 44.6 mm. 50. Syntype of *Mancinella pyrum* (Dillwyn); length 44.0 mm.

1817. *Murex pyrum* Dillwyn, Desc. cat. rec. shells, 2: 707 (refers to Chemnitz, *op. cit.*, figs. 1847-48) [non Linnaeus, 1758].

Dimensions of syntype: 44.0 x 31.0 mm.

Murex pyrum Dillwyn, 1817, is a primary homonym of *M. pyrum* Linnaeus, 1758, and a synonym of *Mancinella alouina* (Röding, 1798) [= *M. mancinella* of authors]. The species has an Indo-Pacific distribution.

Figs. 51, 52. Syntype of *Purpura strigosa* (Gmelin); length 41.4 mm. 52. Syntype of *Vitularia miliaris* (Gmelin); length 55.0 mm.

Purpura strigosa (Gmelin, 1791) (Fig. 51)

1780. *"Buccinum flammeum"* Chemnitz, Syst. Conch. Cab., 4: 62, vignette 38a, b on p. 49 (Hab:?) [*non binom.*]

1791. *Buccinum strigosum* Gmelin, Syst. Nat., ed. 13, p. 3494 (refers to Buonanni, Mus. Kirch., 3, fig. 38 and Chemnitz, *op. cit.*, vig. 38a, b) (Hab:?) [*non B. strigosum* Gmelin, 1791, p. 3476; *nec* p. 3488].

1839 *Murex strigosus* Anton, Verz. Conchyl., p. 82 (refers to Chemnitz, *op. cit.*, vig. 38).

1844. *Purpura buccinea* Deshayes in Deshayes & Edwards, Hist. nat. anim. s. vert., ed. 2, 10: 92 (New Guinea).

1852. *Purpura (Stramonita) flammea* Mörch, Cat. Conchyl. Yoldi, 1: 90 (refers to Chemnitz, *op. cit.*, vig. 38).

Dimensions of syntype: 41.4 x 21.5 x 26.3 mm; shell slightly immature, sculptured with axial ribs and nodulose spiral cords, anterior of columella protruding into aperture and forming a blunt tooth, adjacent area of columella with 5 small plications, aperture striate.

Purpura buccinea Deshayes, 1844, will have to replace the homonymous *Buccinum strigosum* Gmelin, 1791 (p. 3494). The species lives in the S.W. Pacific and the most frequently cited locality is New Guinea.

Vitularia miliaris (Gmelin, 1791) (Fig. 52)

1788. *"Murex purpura scabra"* Chemnitz, Syst. Conch. Cab., 10: 246, pl. 161, figs. 1532-35 (Nicobar Ids.) [*non binom.*]

1791. *Murex miliaris* Gmelin, Syst. Nat., ed. 13, p. 3536 (refers to Valentyn, Knorr, Martini and Chemnitz, *op. cit.*, figs. 1532-35 (Hab:?).

1798. *Purpura onagrina* var. b Röding, Mus. Bolten., p. 139 (refers to Chemnitz, *op. cit.*, figs. 1532-35

1843. *Murex purpura* Deshayes in Deshayes & Edwards, Hist. nat. anim. s. vert., ed. 2, 9: 595, footnote (among other references, cites Chemnitz, *op. cit.*, figs. 1532-35).

Dimensions of syntype (Chemnitz figs. 1532-33): 55.0 x 32.4 mm.

Only the large specimen from the Spengler collection is extant at the Museum. The species is widely distributed throughout the tropical Indo-Pacific.

Family BUCCINIDAE

Siphonalia varicosa (Röding, 1798) (Fig. 53)

1788. *"Murex varicosus"* Chemnitz, Syst. Conch. Cab., 10: 256, pl. 162, figs. 1546-47 (Cape of Good Hope = error?) [*non binom.*]

1798. *Neptunea varicosa* Röding, Mus. Bolten., p. 116 (refers to Chemnitz, *op. cit.*, figs. 1546-47).

1802. *Murex varicosus* Holten, Enum. syst. Conchyl. Chemnitzii, p. 63 (refers to Chemnitz, *op. cit.*, fig. 1546).

Dimensions of syntype: 37.7 x 22.0 mm; shell with 8 axial ribs on each of the last 2 whorls, 12 spiral threads on the penultimate and 30 on the body whorl, columella smooth, edge of outer lip plicate.

Chemnitz (*op. cit.*) described the species from South Africa, but it has not been reported in subsequent faunal lists from that area. Thiele (1929) and Wenz (1941) report the species from Peru, the former with a query. Winkworth (1943), who

unnecessarily designated *Murex varicosus* as the type-species of *Pseudoneptunea* Kobelt, 1882, states that the species has been taken by Archer living near Singapore and adds that it has been recorded from Surabaya, Indonesia, by Oostingh. Vokes (1971), who retains Holten's authorship for the species, reports it from Peru, but Keen (1971) does not list the species.

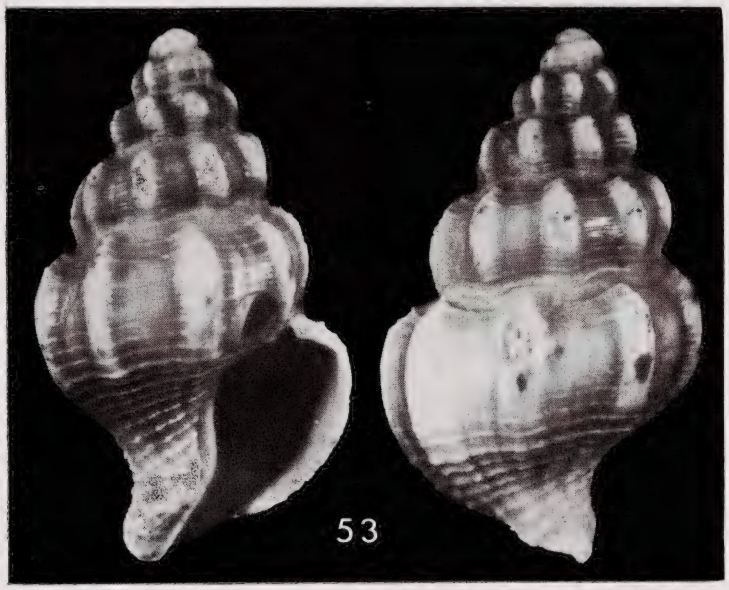


Fig. 53. Syntype of *Siphonalia varicosa* (Röding); length 37.7 mm.

Family MELONGENIDAE

Volema pyrum (Gmelin, 1791) (Figs. 54, 55)

1777. *"Pyrum paradisiacum"* Martini, Syst. Conch. Cab., 3: 202, pl. 94, figs. 909-10 (Coast of Coromandel and Red Sea) [*non binom.*]

1791. *Buccinum pyrum* Gmelin, Syst. Nat., ed. 13, p. 3484 (refers to Martini, *op. cit.*, figs. 909-10) [India and Red Sea].

1798. *Volema paradisiaca* Röding, Mus. Bolten., p. 58, (refers to Martini, *op. cit.*, figs. 909-10).

1817. *Pugilina laevis* Schumacher, Essai nouv. syst., p. 216 (refers to Martini, *op. cit.*, figs. 909-10).

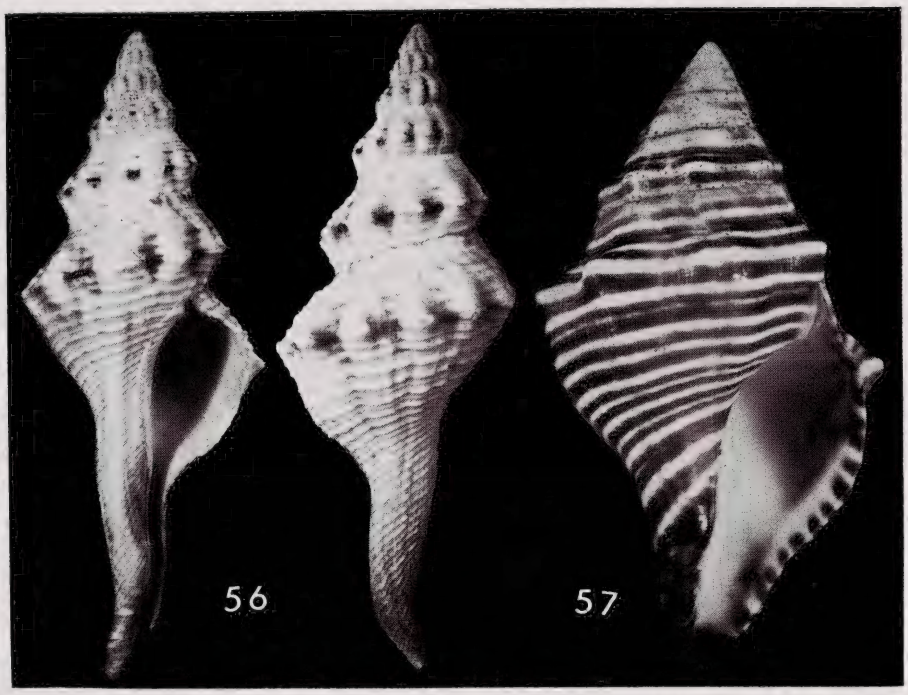
1822. *Pyrula citrina* Lamarck, Hist. nat. anim. s. vert., 7: 146 (refers to Martini, *op. cit.*, figs. 909-10).

Dimensions of holotype: 41.3 x 27.7 mm; shell with 6 spiral threads at the suture and *c.* 14 threads at the base of the body whorl, shoulder concave, aperture heavily calloused and orange in colour, outer lip plicate; columella smooth.

The species lives in the Western Indian Ocean and the Red Sea. The specimen subsequently illustrated by Chemnitz from the Red Sea (Martini & Chemnitz 1795, vol. 11, pl. 193, figs. 1854-55), and apparently not cited by subsequent authors, is an immature, smooth, dark-lined variant of *V. pyrum* (Fig. 55). This variant has been described as *Buccinum spadiceum* Gmelin, 1791, and var. *undata* Dautzenberg, 1929 (*undata* Dautzenberg, 1923, being a *nomen nudum*).

Figs. 54, 55. *Volema pyrum* (Gmelin). 54. Holotype, length 41.3 mm. 55. Specimen illustrated by Chemnitz (vol. 11, pl. 193, figs. 1854-55), length 70.0 mm.

Iredale (1917) designated *Volema paradisiaca* Röding, 1798, as the type-species of *Volema* Röding, 1798; this species is an objective synonym of *Buccinum pyrum* Gmelin and not *Murex ficus* Gmelin, 1791 (non Linnaeus, 1758) as suggested by Clench & Turner (1956). The inclusion of 2 species in the genus *Pugilina* Schumacher, 1817 (i.e. *P. laevis* and *P. fasciata,* both of Schumacher, 1817) invalidates a type designation by monotypy (Clench & Turner, 1956). The type-species of *Pugilina* Schumacher is *"Fusus morio* L." by subsequent designation by Herrmannsen (1848), a species cited (as *Murex morio* Linnaeus) by Schumacher (*op. cit.*) in the synonymy of his *Pugilina fasciata.*



Figs. 56, 57. 56. Syntype of *Fusinus ansatus* (Gmelin); length 131.3 mm. 57. Syntype of *Latirus amplustris* (Dillwyn); length 42.0 mm.

Family FASCIOLARIIDAE

Fusinus ansatus (Gmelin, 1791) (Fig. 56)

1780. *"Fusu lineatus fuscus"* Chemnitz, Syst. Conch. Cab., 4: 179, pl. 144, fig. 1340 (Hab:?) [*non binom.*]

1791. *Murex ansatus* Gmelin, Syst. Nat., ed. 13, p. 3556 (refers to Regenfuss, vol. 1, pl. 12, fig. 62 and Chemnitz, *op. cit.*, fig. 1340) [Hab:?].

1798. *Syrinx maculata* Röding, Mus. Bolten., p. 122 (refers to Chemnitz, *op. cit.*, fig. 1340).

Dimensions of syntype: 131.3 x 48.8 mm; shell with 11 spiral cords on the penultimate whorl and a row of nodes which are stained with brown in the interspaces, columella and outer lip plicate.

The species ranges from the Philippine Islands westward into the Indian Ocean. *Fusus distans* Lamarck, 1822, appears to be the same species.

Latirus amplustris (Dillwyn, 1817) (Fig. 57)

1795. *"Murex amplustris"* Chemnitz, Syst. Conch. Cab., 11: 119, pl. 191, figs. 1841-42 (Tonga Ids.) [*non binom.*]

1817. *Murex amplustre* Dillwyn. Desc. cat. Rec. shells, 2: 735 (refers to Chemnitz, *op. cit.*, figs. 1841-42 and Martyn, 1784, vol. 1, pl. 3) [N.W. coast of America = error, and Tonga Ids.].

Dimensions of syntype: 42.0 x 24.2 mm.

The N.W. American locality cited by Dillwyn (1817) is erroneous, and the species lives in the tropical Indo-Pacific.

Family MITRIDAE

Mitra (Nebularia) aurantia (Gmelin, 1791) (Fig. 58)

1780. *"Turricula arausiaca"* Chemnitz, Syst. Conch. Cab., 4: 231, pl. 150, figs. 1393-94 (Hab:?) [*non binom.*]

1791. *Voluta aurantia* Gmelin, Syst. Nat., ed. 13, p.3454 (refers to Chemnitz, *op. cit.*, figs. 1393-94) [Hab:?].

1798. *Mitra minuta* Röding, Mus. Bolten., p. 137 (refers to Chemnitz, *op. cit.*, figs. 1393-94).

Dimensions of holotype: 28.2 x 13.2 x 17.1 mm; specimen faded orange, spirally striate, outer lip crenulate, columella with 4 oblique folds.

This is the species which was subsequently described as *Mitra aurantiaca* Lamarck, 1811 and *M. crassa* Swainson, 1822. The species has an Indo-Pacific distribution.

Family VEXILLIDAE

Vexillum (Costellaria) virgo (Linnaeus, 1767) (Fig. 59)

1767. *Voluta virgo* Linnaeus, Syst. Nat., ed. 12, p. 1192 (Hab:?); 1791 Gmelin, Syst. Nat., ed. 13, p. 3450 (Hab:?); 1955 Dodge, Bull. Americ. Mus. Nat. Hist., 107 (1): 105.

1791. *Voluta cruentata* Gmelin, Syst. Nat., ed. 13, p. 3453 (Indian Ocean).

1811. *Mitra harpifera* Lamarck, Ann. Mus. d'Hist. Nat. Paris, 17: 217 (Indian Ocean).

1822. *Mitra harpaeformis* Lamarck, Hist. nat. anim. s. vert., 7: 319.

Dimensions of 3 syntypes: 22.5 x 8.0 x 11.0 mm; other 2 syntypes length 19.0 mm and 18.0 mm.

Voluta virgo Linnaeus, has always been considered a *nomen dubium* since no illustrations were cited and the locality was unknown. The taxonomic problem surrounding *V. virgo* was discussed in detail by Dodge (1955). Linnaeus (1767) acknowledged receiving specimens of *V. virgo* from Spengler, and 3 syntypes of the species with the Linnaean "Systema" number 416 added in Spengler's handwriting, are present in the Zoological Museum, Copenhagen. These syntypes are the Indo-Pacific species *Vexillum (Costellaria) cruentatum* (Gmelin, 1791) [= *M. harpifera* and *M. harpaeformis* of Lamarck], which displays the diagnostic features of blood-red axial ribs on at least the sutural nodes, and mentioned as "linea sanguinea" in Linnaeus' diagnosis.

Despite the fact that *Voluta virgo* Linnaeus, is considered an unused senior synonym (Dodge's 1955 usage does not qualify, since the name has not been applied to a valid taxon), it will, after all, replace the later *V. cruentata* Gmelin. The latter taxon has been used only 3 times by 2 different authors during the preceding 50 years and falls considerably short of the 10 times usage by 5 different authors of the current requirement of the Code of I.C.Z.N.

Vexillum (Costellaria) granosum (Gmelin, 1791) (Fig. 60)

1788. *"Voluta granosa"* Chemnitz, Syst. Conch. Cab., 10: 173, pl. 151, figs. 1442-43 (East Indian Seas) [*non binom.*]

1791. *Voluta granosa* Gmelin, Syst. Nat., ed. 13, p. 3453 (refers to Chemnitz, *op. cit.*, figs. 1442-43) [Indian Ocean].

Figs. 58-61. 58. Holotype of *Mitra (Nebularia) aurantia* (Gmelin); length 28.2 mm. 59. Syntype of *Vexillum (Costellaria) virgo* (Linnaeus); length 22.5 mm. 60. Holotype of *V. (C.) granosum* (Gmelin); length 29.7 mm. 61. Holotype of *V. (Pusia) patriarchalis* (Gmelin); length 22.0 mm.

1798. *Mitra cancellata* Röding, Mus. Bolten., p. 138 (refers to Chemnitz, *op. cit.*, figs. 1442-43).

Dimensions of holotype: 29.7 x 9.2 x 14.2 mm.

This well-known species is widely distributed throughout the tropical Indo-Pacific and ranges from Zanzibar to the Fiji Islands.

Vexillum (Pusia) patriarchalis (Gmelin, 1791) (Fig. 61)

1788. *"Voluta corono patriarchalis"* Chemnitz. Syst. Conch. Cab., 10: 166, pl. 150, figs. 1425-26 (East Indian Seas) [*non binom.*]

1791. *Voluta patriarchalis* Gmelin, Syst. Nat., ed. 13, p. 3460 (refers to Chemnitz, *op. cit.*, figs. 1425-26) [Indian Ocean].

Dimensions of probable holotype: 22.0 x 13.3 x 12.3 mm; shell faded and worn.

The probable type-specimen has lost its usually prominent spines due to wear. The species lives in the tropical Indo-Pacific.

Family TURRIDAE

Perrona perron (Gmelin, 1791) (Fig. 62)

1788. *"Murex perron"* Chemnitz, Syst. Conch. Cab., 10: 278, pl. 164, figs. 1573-74 (South Seas = error) [*non binom.*]

1719. *Murex perron* Gmelin, Syst. Nat., ed. 13, p. 3559 (refers to Chemnitz, *op. cit.*, figs. 1573-74 and Davila, vol. 1, pl. 5, fig. I) [Southern Ocean = error].

1817. *Perrona tritonum* Schumacher, Essai nouv. syst., p. 218 (refers to Chemnitz, *op. cit.*, figs. 1573-74).

Dimensions of syntype: 35.2 x 14.0 x 19.1 mm; five postnuclear whorls with oblique axial ribs, lower half of body whorl with 9 main spiral cords and additional finer intermediate threads.

The species most probably lives in West Africa but this locality has not been substantiated by either literature records or authentic specimens. Another possibility is that *Murex perron* is conspecific with *Pleurotoma spirata* Lamarck, 1816, as suggested by Nordsieck (1968), although the two species appear quite distinct.

Clavatula regia (Röding,1798) (Figs. 63, 64)

1780. *"Turris babylonica coronata"* Chemnitz, Syst. Conch. Cab., 4: 176, vignette 39, fig. C (probably East Indies = error) [*non binom.*]

1798. *Turris regia* Röding, Mus. Bolten., p. 124 (refers to Chemnitz, *op. cit.*, vig. 39, fig. C).

1816. *Pleurotoma conica* Lamarck, Tabl. Encycl. Méth., p. 9, pl. 439, figs. 9a, b.

1817. *Murex clavatulus* Dillwyn (*pars*), Desc. cat. Rec. shells, 2: 713 (among oher references cites Chemnitz, *op. cit.*, vig. 39, fig. C) [coasts of Guinea].

1822. *Pleurotoma muricata* Lamarck, Hist. nat. anim. s. vert., 7: 91 (Hab:?).

1852. *Pleurotoma (Clavatula) coronata* Mörch, Cat. Conchyl. Yoldi, 1: 72 (refers to Chemnitz, *op. cit.*, vig. 39, fig. C) [*non* Muenster, 1844; *nec Clavatula coronata* Lamarck, 1801.

Dimensions of 3 syntypes: 37.4 x 16.6 x 17.7 mm; other two syntypes length 41.5 mm and 35.8 mm.

The species lives in West Africa and is generally cited as *Clavatula muricata* (Lamarck) in literature. Chemnitz (Martini & Chemnitz 1795) stated that his illustrations in vol. 11, plate 190, figs. 1831-32 are re-drawn figures of the species represented in Chemnitz, vol. 4, vignette 39, fig. C. Figures 1831-32 were Dillwyn's first citation for his *Murex clavatulus*. The 2 syntypes of *Pleurotoma conica* Lamarck, which are also the syntypes of *P. muricata* Lamarck, are in the Muséum d'Histoire Naturelle, Geneva, no. 1097/49/1 (Fig. 64).

Figs. 62-64. 62. Syntype of *Perrona perron* (Gmelin); length 35.2 mm. 63, 64. *Clavatula regia* (Röding). 63. Syntype, length 37.4 mm. 64. Syntype of *Pleurotoma conica* Lamarck and *P. muricata* Lamarck (Mus. d'Hist. Nat. Geneva, No. 1097/49/1); length 45.5 mm, width 22.2 mm.

Family CONIDAE

Conus tenellus Holten, 1802 (Fig. 65)

1792. *Conus nimbosus* Hwass in Bruguière, Encycl. Méth. vers, pt. 2, p. 732.

1795. *"Conus tenellus"* Chemnitz, Syst. Conch. Cab., 11: 64, pl. 183, figs. 1782-83 (Moluccas) [*non binom.*]

Figs. 65, 66. 65. Holotype of *Conus tenellus* Holten; length 33.6 mm. 66. Syntype of *C. cinereus* var. C Hwass in Bruguière; length 43.0 mm.

1802. *Conus tenellus* Holten, Enum. syst. Conchyl. Chemnitzii, p. 39 (refers to Chemnitz, *op. cit.*, figs. 1782-83); 1817 Dillwyn, Desc. cat. Rec. shells, 1: 417 (same reference).

Dimensions of holotype: 33.6 x 15.8 x 30.8 mm.

The species illustrated as "*Conus tenellus* Dillwyn" by Marsh & Rippingale (1964) is not the *C. tenellus* of either Dillwyn or Holten. The extant type-specimen of *C. tenellus* is the same species as the Indo-West Pacific *C. nimbosus* Hwass in Bruguière, 1972.

Conus cinereus Hwass in Bruguière, 1792 (Fig. 66)

1788. "*Conus monachus franciscanus*" Chemnitz, Syst. Conch. Cab., 10: 68, pl. 142, fig. 1319 (East Indies) [*non binom.*]

1791. *Conus monachus* var. b Gmelin, Syst. Nat., ed. 13, p. 3382 (refers to Chemnitz, *op. cit.*, 1319-20) [non Linnaeus, 1758].

1792. *Conus cinereus* var. C Hwass in Bruguière, Encycl. Méth. vers, p. 674 (among other references cites Chemnitz, *op. cit.*, fig. 1319).

1817. *Conus rusticus* var. C Dillwyn, Desc. cat. Rec. shells, 1: 387 (refers to Chemnitz, *op. cit.*, fig. 1319) [non Linnaeus, 1758].

Dimensions of syntype: 43.0 x 21.0 mm.

No separate name appears to have been proposed for the specimen illustrated in Chemnitz's figure 1319. The specimen figured by Chemnitz (*op. cit.*) is *Conus cinereus* Hwass in Bruguière, 1792 from the Indian Ocean.

Family VENERIDAE

Meretrix lusoria (Röding, 1798) (Fig. 67)

1782. "*Venus lusoria japonica*" Chemnitz, Syst. Conch. Cab., 6: 337, pl. 32, fig. 340 (coasts of China and Japan) [*non binom.*]

1798. *Venus lusoria* Röding, Mus. Bolten., p. 180 (refers to Chemnitz, *op. cit.*, fig. 340).

Dimensions of syntype: 60.0 x 73.7 mm.

Both valves have an identical scene painted on the interior in blue, gold, green, red and black. Chemnitz (1782) devotes considerable space in his description to explanations of usage of these painted bivalves in Chinese and Japanese games. The species occurs in the Sino-Japanese region and is probably conspecific with *Meretrix meretrix* (Linnaeus, 1758).

Acknowledgements. I would like to express my sincere thanks to Dr J. Knudsen, University Zoological Museum, Copenhagen, for the facilities made available during my stay at the Museum and for information and literature pertaining to the Chemnitz-Spengler-Moltke collection.

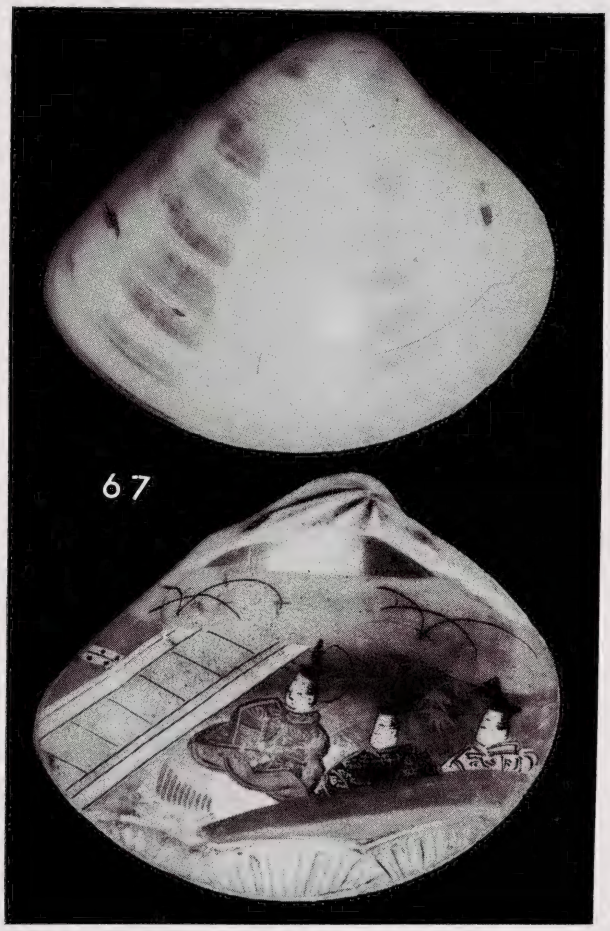


Fig. 67. Syntype of *Meretrix lusoria* (Röding); height 60.0 mm.

REFERENCES

ABBOTT, R. T.

1854 *American Seashells.* New York, van Nostrand Co. Inc. 541 pp. 40 pl.; textfigs.

ADAM, W. and E. LELOUP

1938 Résultats scientifiques du voyage aux Indes Orientales Néerlandaises. *Mém. Mus. Roy. d'Hist. Nat. Belg.* 2 (19): 1-209; pl. 1-8.

ADAMS, A.

1853 Contributions towards a monograph of the Trochidae, a family of gasteropodous Mollusca. *Proc. Zool. Soc. London* for 1851 (19): 150-192.

ANTON, H. E.

1839 *Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden.* Halle, E. Anton, pp. i-xvi; 1-110.

CERNOHORSKY, W. O.

1971 The family Naticidae (Mollusca: Gastropoda) in the Fiji Islands. *Rec. Auckland Inst. Mus.* 8: 169-208; 70 textfigs.

1972 Type specimens of Recent and fossil Mollusca described by H. J. Finlay. Part 1. (Scissurellidae-Turbinidae). *Rec. Auckland Inst. Mus.* 9: 231-247; 21 textfigs.

CLENCH, W. J. and R. D. TURNER

1956 The family Melongenidae in the western Atlantic. *Johnsonia* 3 (35): 161-188; pl. 94-109.

DESHAYES, G. P. and H. MILNE EDWARDS

1843 *Histoire naturelle des animaux sans vertèbres.* Ed. 2. Paris, J. B. Baillière. 9: 1-728.

DILLWYN, L. W.

1817 *A descriptive catalogue of Recent shells, arranged according to the Linnaean method.* London, J. & A. Arch. 1: 1-580; 2: 581-1092.

DODGE, H.

1955 A historical review of the mollusks of Linnaeus. Part 3. The genera *Bulla* and *Voluta* of the Class Gastropoda. *Bull. Americ. Mus. Nat. Hist.* 107 (1): 1-157.

FAUSTINO, L. A.

1928 *Summary of Philippine marine and fresh-water Mollusks.* Manila, Bureau of Science. 384 pp.

GMELIN, J. F.

1791 *Systema naturae per regna tria naturae. Editio decima tertia, aucta, reformata.* Leipzig. 1 (6): 3021-3910.

HEMMING, F. (Editor)

1958 *Official Index of Rejected and Invalid works in Zoological Nomenclature.* London. pp. i-x; 1-14.

HERRMANNSEN, A. N.

1847-48 *Indicis generum malacozoorum primordia.* Cassel, T. Fischer. 2: 1-717.

HOLTEN, H. S.

1802 *Enumeratio systematica Conchyliorum beat. J. H. Chemnitzii.* Copenhagen, K. H. Seidelini. 85 pp.

IREDALE, T.

1917. More molluscan generic name-changes, generic and specific. *Proc. Malac. Soc. London* 12: 322-330.

KAICHER, S. D.

1957 *Indo-Pacific Sea-shells. Muricacea, Buccinacea.* Meinders, Clearwater. 9 pl. and text.

KEEN, A. M.

1971 *Sea shells of tropical west America. Ed. 2.* California, Stanford University Press. 1064 pp.; 22 pl.; textfigs.

KNUDSEN, J.

1956 Marine prosobranchs of tropical West Africa (Stenoglossa). *Atlantide Report* No. 4: 1-110; pl. 1-4.

KURODA, T., T. HABE and K. OYAMA

1971 *The Sea shells of Sagami Bay*. Tokyo, Maruzen Co. Ltd. pp. 1-741; 1-489; 121 pl.

LINK, H. F.

1807 *Beschreibung der Naturalien-Sammlung der Universität zu Rostock. Mollusca.* Rostock, Adlers Erben. Pt. 2/3: 82-160; Pt. 4: 6-23.

LINNAEUS, C.

1767 *Systema naturae per regna tria naturae. Editio duodecima, reformata.* Stockholm. 1 (2): 533-1327.

MARSH, J. A. and O. H. RIPPINGALE

1964 *Cone shells of the world*. Brisbane, Jacaranda Press. 166 pp.; 22 pl.

MARTINI, F. H. W. and J. H. CHEMNITZ

1769-95 *Neues systematisches Conchylien-Cabinet.* Nürnberg, G. N. Raspe. 1: 1-408, pl. 1-31 (1769); 2: 1-362, pl. 32-65 (1773); 3: 1-434, pl. 66-121 (1777) [vols. 1-3 authored by Martini]. 4: 1-344, pl. 122-159 (1780); 5: 1-324, pl. 160-193 (1781); 6: 1-375, pl. 1-36 (1782); 7:1-356, pl. 37-69 (1784); 8: 1-372, pl. 70-102 (1785); 9 (1): 1-151, pl. 103-116, 9 (2): 1-194, pl. 117-136 (1786); 10: 1-376, pl. 137-173 (1788); 11: 1-312, pl. 174-213 (1795) [vols. 4-11 authored by Chemnitz].

MOERCH, O. A. L.

1852-53 *Catalogus Conchyliorum quae reliquit D'Alphonso d'Aguirra & Gadea Comes de Yoldi.* Copenhagen, L. Klein. Pt. 1: 1-170 (1852); Pt. 2: 1-76 (1853).

NORDSIECK, F.

1968 *Die europäischen Meeres-Gehäuseschnecken (Prosobranchia) vom Eismeer bis Kapverden und Mittelmeer.* Stuttgart, G. Fischer. 273 pp.; 31 pl.

PFEIFFRR, L.

1840 *Kritisches Register zu Martini und Chemnitz's systematischem Konchylien-Kabinet.* Kassel, T. Fischer. pp. i-viii; 1-112.

REEVE, L.

1855 *Conchologia Iconica. Monograph of the genus Nerita.* London, L. Reeve. 19 pl. and text.

ROEDING, P. F.

1798 *Museum Boltenianum sive catalogus cimeliorum e tribus regnis naturae. Pars secunda.* Hamburg, J. C. Trappi. pp. i-viii; 1-199.

SCHUBERT, H. G. and J. A. WAGNER

1829 *Neues systematisches Conchylien-Cabinet angefangen von Martini und Chemnitz.* Nürnberg, Bauer & Raspe. 12: i-xii; 1-196; pl. 214-237.

SCHUMACHER, C. F.

1817 *Essai d'un nouveau systéme des habitations des Vers testacés.* Copenhagen. pp. i-iv; 1-287; 22 pl.

THIELE, J.

1929-31 *Handbuch der systematischen Weichtierkunde.* Jena, G. Fischer. 1: 1-778; textfigs.

TRYON, G. W.

1888 *Manual of Conchology.* Philadelphia. 10: 1-323; pl. 1-69 (from p. 161 continued by H. A. Pilsbry).

1889 *Manual of Conchology.* Philadelphia. 11: 1-519; pl. 1-67 (authored by H. A. Pilsbry).

VOKES, E. H.

1971 Catalogue of the genus *Murex* Linné (Mollusca: Gastropoda); Muricinae, Ocenebrinae. *Bull. Americ. Paleont.* 61 (268): 1-141.

WARMKE, G. L. and R. T. ABBOTT

1961 *Caribbean Seashells.* Narberth, Livingston Publ. Co. 346 pp.; 44 pl.

WENZ, W.

1941-44 *Handbuch der Paläozoologie.* Berlin, Gebr. Borntraeger. 6 (5-7): 949-1639; textfigs.

WINKWORTH, R.

1943 Holten's systematic list of shells of Chemnitz. *Proc. Malac. Soc. London* 25 (4): 146-150; pl. 5.

THREE RADIOCARBON DATES FOR QUATERNARY MOLLUSCA FROM NORTHLAND

C. A. FLEMING * AND A. W. B. POWELL **

* N.Z. GEOLOGICAL SURVEY, LOWER HUTT

** AUCKLAND INSTITUTE AND MUSEUM

Abstract. Shells of the warm-water bivalve *Anadara trapezia* (Deshayes), no longer living in New Zealand, have been dated as more than 46,300 years old (Hokianga) and more than 40,100 years old (Marsden Point), thus probably Interglacial in age, and there is no evidence that this species returned during the Holocene after its extinction probably in the Last Glaciation.

Placostylus ambagiosus priscus Powell, the oldest known New Zealand *Placostylus,* from consolidated dune sands near Cape Maria Van Diemen, previously classed as presumably Pleistocene, is dated as 2140 ± 90 years old and is thus considerably younger than previously thought.

This paper records the radiocarbon ages determined for two well-known subfossil molluscs, mainly based on samples from Auckland Museum collections.

Anadara trapezia (Deshayes)

Since it was first recorded from New Zealand by Oliver (1923), the "Sydney Mud Cockle" has been reported in a number of localities on the North Island coast. Crozier (1962) listed 16 New Zealand occurrences, another is added below and there are doubtless still more, unknown to the writers.

A few of the occurrences are in beds classed as Castlecliffian, thus of early Pleistocene Interglacial age, but others are in superficial beds not far above or below present sea level, so that Fleming (1962; see also 1963) suggested a post-glacial date for the occurrences at Kohukohu, Hokianga, described by Powell (1932) and in shallow wells at Marsden Point (see below).

The Marsden Point record is based on juvenile valves associated with a diverse assemblage of more than 30 species of molluscs, cirripedes and brachiopods (N24/602, GS 9151 in N.Z. Geological Survey) obtained from drill cuttings from a depth of 12.2 m, i.e., approximately 0.6 m below sea level in Marsden Point Oil Installation Water Drillhole No. 3, and forwarded for dating by Dr D. Kear, N.Z. Geological Survey (N24/602, GS 9151). It was dated as older than 40,100 years B.P. (Institute of Nuclear Sciences, N.Z. 539).

Following this result, specimens in Auckland Museum from Kohukohu (old mud, collected by E. D. Pritchard between tides, a little to the west of Kohukohu Wharf, including shells with both valves, *in situ;* N14/496) were submitted for dating. They proved to be greater than 46,300 years old (N.Z. 1592).

The Marsden Point and Kohukohu *Anadara,* being warm-water organisms older than 40,000 years, are probably at least as old as Last Interglacial (say 80,000 to 120,000 years old), if not older still, and there is no evidence that any of the other occurrences are post-glacial, i.e. Holocene.

Placostylus ambagiosus priscus (Powell)

The living and extinct forms of the genus *Placostylus* in the far north of Northland (Powell 1938, 1947) include living populations and subfossil populations from consolidated dune sands, occurring with other land molluscs and bird bones representing the fauna of rain forest that was overwhelmed by periodic advances of coastal dunes.

The oldest known *Placostylus, P. ambagiosus priscus* (Powell 1938), occurs in consolidated dunes, stained to a pinkish brown hue, in an area surrounding Herangi Trig. Station, 213 m (the 700 ft hill mentioned by Powell 1947). This dune sand, assumed to be Pleistocene from its colouration and consolidation, was mapped as Holocene by Kear & Hay (1961).

Samples of *P. ambagiosus priscus* in Auckland Museum, collected from the type locality (by A. W. B. P.), were carefully cleaned of sand, examined to ensure that no recrystallisation to calcite had taken place, and submitted for dating; the result, 2140 ± 90 years B.P. (N.Z. 1950, new half life, corrected for secular effect) indicates that the sequence of dune advances and the *Placostylus* populations they destroyed are considerably younger than had been thought.

The possibility of any significant error in this result is negligible, since the age has been calculated in relation to the New Zealand land snail standard for Northland (Rafter *et al.* 1972), determined from *Placostylus* collected alive at Spirits Bay in 1946. The isotopic determinations from New Zealand *Placostylus* shell showed no noticeable effect due to assimilation of ancient carbonate into their shells. Moreover, Mr E. J. Cox, Soil Bureau, D.S.I.R., Whangarei, comments (*in litt.* to C.A.F.) that he would not expect shells to survive more than a few tens of thousands of years, since Pleistocene sands are deeply leached. Fire is the most likely cause of the sand dune advance and forest destruction, but what, some 2140 years ago, lit fires is an unanswered question.

Rafter *et al.* (1972: H53-57) published a wide span of apparent ages for *Placostylus* in an archaeological context at Ile des Pines, New Caledonia. A much greater age for a fossil *Placostylus* from the fossil dune sequence at Lord Howe Island was recorded in a paper by Squires (1963, pp. 412-413).

Fossil examples of the endemic land snail, *Placostylus bivaricosus,* which is still living on the island, occurred in a 25.4 mm (12 in.) thick, brown loamy horizon in coral-sand rock, with an overlay of 15.24-24.38 m (50-80 ft) of steeply-dipping, partially lithified, aeolianite sands, representing a relatively undisturbed profile. The age determined for these Lord Howe Island fossils (N.Z. 442) was 27,200 ± 700 years but was incorrectly reported as 20,700 ± 700 years. (This sample was not examined for assimilation of old carbonate.)

Unfortunately the Herangi *P. ambagiosus priscus* site does not present a profile since it has been subjected to great erosion, almost completely removing the former overlay. Photographs taken in the area between 1902 and 1906, and a Lands and Survey unpublished sketch map made about the same time, indicate that the slopes of Herangi were then already eroded to much the same extent as they are today.

Acknowledgements. We are grateful to Mr J. E. Cox, Soil Bureau, for his comments on the age of dune sands near Cape Maria Van Diemen, and Mr T. L. Grant-Taylor, N.Z. Geological Survey, for help with assessment of the radiocarbon dates which were supplied by the N.Z. Institute of Nuclear Sciences.

REFERENCES

CROZIER, M.

1962 New Zealand occurrences of the Sydney mud cockle, *Anadara trapezia* (Deshayes). *Rec. Dominion Mus.* 4 (13): 143-48.

FLEMING, C. A.

1962 The extinction of moas and other animals during the Holocene Period. *Notornis* 10 (3): 113-17.

1963 Evidence for ecologically significant changes in climate during the post-glacial period in New Zealand. *Proc. N.Z. Ecol. Soc.* 10: 48-52.

KEAR, D. and R. F. HAY

1961 Sheet 1, North Cape (1st Ed.). "Geological Map of New Zealand 1:250,000". Department of Scientific and Industrial Research, Wellington, N.Z.

OLIVER, W. R. B.

1923 Notes on New Zealand Pelecypods. *Proc. Malac. Soc. London* 15: 179-88.

POWELL, A. W. B.

1932 On some New Zealand Pelecypods. *Proc. Malac. Soc. London* 20: 65-72.

1938 The Paryphantidae of New Zealand No. IV, and the genus *Placostylus* in New Zealand. *Rec. Auckland Inst. Mus.* 2 (3): 133-50.

1947 Distribution of *Placostylus* land snails in northernmost New Zealand. *Rec. Auckland Inst. Mus.* 3 (3): 173-88.

RAFTER, T. A., H. S. JANSEN, L. LOCKERBIE and M. M. TROTTER

1972 New Zealand Radiocarbon Reference Standards. *8th International Conference Radiocarbon Dating (N.Z.) Proc.* 2: H29-79.

SQUIRES, D. F.

1963 Carbon-14 Dating of the Fossil Dune Sequence, Lord Howe Island. *Aust. J. Sci.* 25 (9): 412-13.

NEW ZEALAND MOLLUSCAN SYSTEMATICS WITH DESCRIPTIONS OF NEW SPECIES

PART 8

A. W. B. POWELL
AUCKLAND INSTITUTE AND MUSEUM

Abstract. In this part, an Australian genus and species new to the New Zealand fauna is added, with the recording of *Myochama tasmanica* from Parengarenga Harbour; a new species of *Pterochelus* is described; the upper Pleistocene *Thracia vegrandis* is found to be represented in the Recent fauna; seven species mostly of tropical Indo-Pacific origin are added to our Recent fauna, along with five others on an at present tentative basis; four species previously recorded as new to the fauna are now found to be firmly established; and the paper concludes with some nomenclatural notes.

(A) *A genus and species of Australian origin new to the New Zealand fauna*

Family MYOCHAMIDAE

Genus **Myochama** Stutchbury, 1830

Type species (monotypy) *M. anomioides* Stutchbury, 1830.

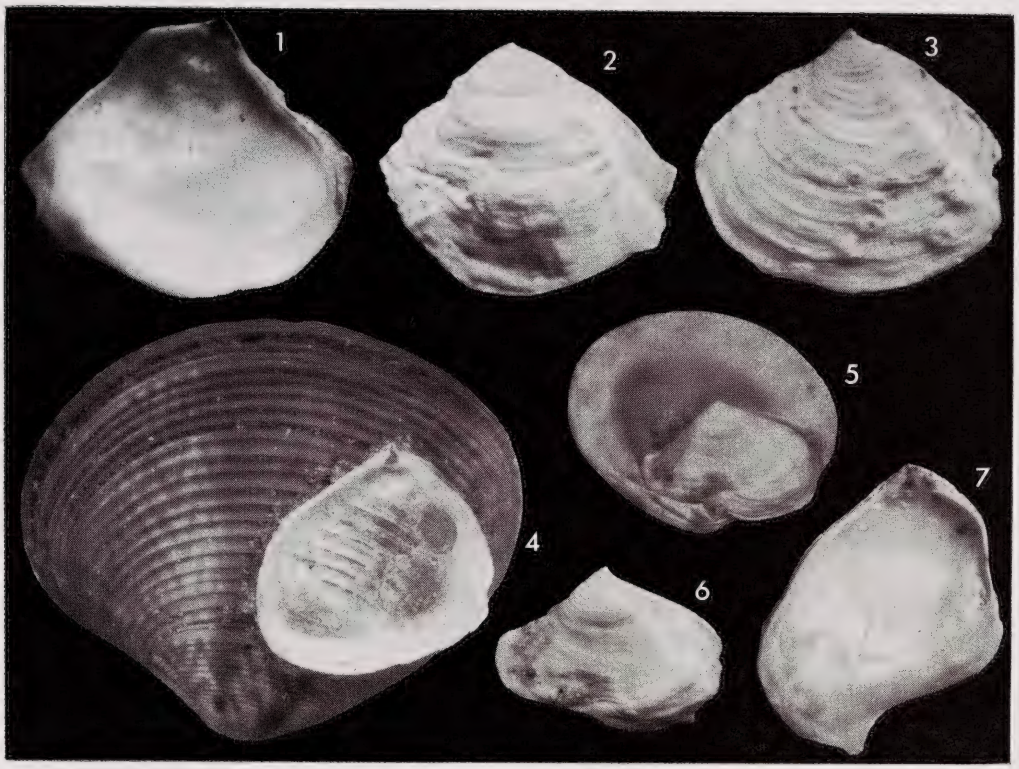
Shell inequivalve, sessile, attached by the right valve, and modified in form and in sculpture by the surface of attachment.

Myochama tasmanica (Tenison Woods, 1877) (Figs. 1-8)

1877 *Gouldia tasmanica* Tenison Woods, Proc. R. Soc. Tasmania (for 1876): 160.

1901 *Myochama tasmanica* (Tenison Woods); Tate & May, Proc. Linn. Soc. N.S.W. 26: 461, fig. 13.

Adult shell of very irregular shape and proportions, 9-14 mm in width. Nepionic part of shell regularly trigonal, with small posteriorly inclined beaks, 3.2-6.75 mm in width, sculptured with strong rather widely spaced rounded concentric ridges, occasionally anastomosing. After this stage the shell takes on all manner of shapes, induced by the surface to which it becomes adherent; the concentric sculpture loses any semblance of regularity and flattens out into haphazard growth lines and folds. The free left valve has a weak posterior ridge that terminates in a slight squarish truncation. Pallial sinus of moderate depth. Internal surface of left valve, within the pallial line deeply scored by irregular radial grooves; right valve without radial grooves, but reproducing the surface irregularities and sculpture of the host shell. Hinge with a deep narrow wedge-shaped resilifer, flanked by irregular ridges confluent with the hinge-plate. Colour of exterior dull white; interior slightly pearly. The shell appears to be bi-convex up to 5 mm in length, but no free-living juveniles were obtained in the Parengarenga dredgings. The Tasmanian holotype is a free-living nepionic shell, 3.0 mm wide by 2.5 mm high, and matched that stage in the Parengarenga adults.



Figs. 1-7. *Myochama tasmanica* (Tenison Woods), Parengarenga Harbour, 5.48-7.31 m; size range 9-14 mm. 1, 2, 3, 6 & 7. Left valves. 4. Right valve attached to exterior of *Tawera spissa*. 5. Complete shell attached to interior of *Tawera spissa* valve.

Measurements in mm of Parengarenga shells —

Adult width	adult height	nepionic width	nepionic height
14.0	11.7	3.20	2.75
13.0	11.0	—	—
12.0	7.0	5.00	3.70
11.0	10.5	6.75	5.00
9.0	12.2	—	—

TYPE LOCALITY. Southern Tasmania. "Parasitic on Pectens in channel", W. L. May, *An Illustr. Index of Tasmanian Shells,* pl. 5, fig. 11.

New Zealand locality. Parengarenga Harbour, Northland, 3-4 fathoms (5.48-7.31 m) on coarse shelly bottom, attached to the exterior of living and the interior of dead *Tawera spissa,* or rarely on the inside of *Paphies australis* valves; dredged on several occasions by Messrs Hunt Seelye, Graham Clifford and Norman Gardner.

The writer is indebted to Mrs N. Gardner for the gift of two specimens of the Parengarenga shell for the Auckland Museum and also for the opportunity of studying all of the material collected.

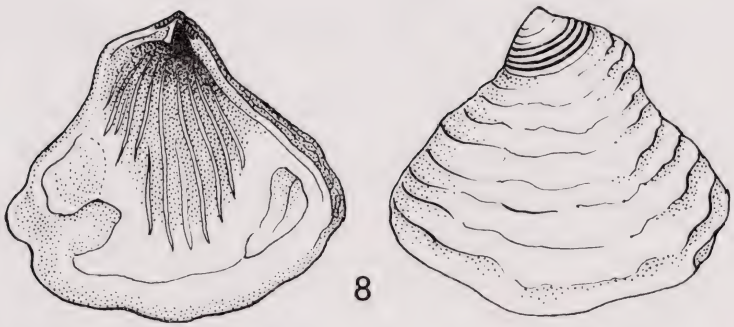


Fig. 8. *Myochama tasmanica* (Tenison Woods), Parengarenga Harbour, 5.48-7.31 m Left valve; interior, showing radial grooves; exterior, showing regularly corrugated nepionic part of shell, followed by irregular adult growth.

(B) *A new species of* Pterochelus

Family MURICIDAE

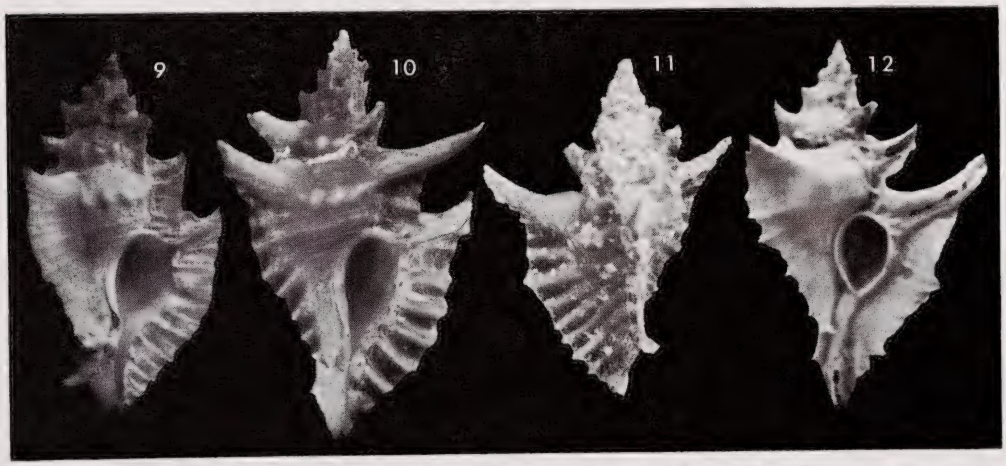
Genus **Pterochelus** Jousseaume, 1880

Type (original designation) *Murex acanthopterus* Lamarck.

(Synonyms *Alipurpura* Fischer, 1884. Type (OD) *M. acanthopterus* Lamk. and *Prototyphis* Ponder, 1972. Type (OD) *Typhis angasi* Crosse, 1863).

Pterochelus paupereques sp. n. (Figs. 10, 11)

1971 *Pterynotus (Pterochelus) zealandicus* (non Hutton 1873), Powell, Rec. Auckland Inst. Mus. 8: 218, figs. 10, 11.



Figs. 9-12. 9. *Pterochelus eos* (Hutton, 1873), Long Beach, Russell; 30 x 16 mm. 10, 11.*Pterochelus paupereques* sp. n. 10. Poor Knights Islands, 9-18 m; 31.75 x 19.75 mm, Holotype. 11. Reef off Henry Island, Whangaruru, 6 m. 12. *Pterochelus zealandicus* (Hutton, 1873), Castlecliff, Wanganui, upper Pleistocene; 31 x 22 mm.

This is the species erroneously attributed to *Pterynotus zealandicus* (Hutton) (Powell 1971, 1.c.p.218). Incidentally Hutton's upper Pleistocene species has been recorded Recent upon the basis of an authentic living example dredged in Cook Strait, 9-10 miles (14.48-16.09 km) north of Cape Farewell in 45-52 fathoms (76.81-95.10 m) (Dell and Fleming 1964, Rec. Dominion Mus. 5 (9): 63-72).

The species *paupereques* resembles *eos* (Fig. 9) in having the peristome interrupted both by the anterior canal and the hollow shoulder spine, and also in the presence of shoulder nodes, but differs from *eos* in its broadly triangulate body-whorl, and long, up-curved, open, shoulder spine. The shell coloration varies from light brown, with reddish-brown spiral streaks, to bright salmon-pink, with dark reddish-brown patches in the hollows of the axial lamellae. The animal is cream coloured, deepening to bright yellow towards the foot. The cephalic tentacles are moderately long, rather sharply pointed, and ledged on the outer side, with a conspicuous black pigmented eye, situated at about one-third back from the tip.

In *zealandicus* (Fig. 12) both the anterior canal and the shoulder spine are closed in the adult, the aperture is entire with a raised rim, and there are no shoulder nodes between the varices, which are broad lamellose flanges.

TYPE LOCALITY. Poor Knights Islands, taken alive at 9-18 m (holotype); also reef off Henry Island, Whangaruru, 6 m, taken alive by Mr W. Palmer of Whangarei.

Holotype. Auckland Institute and Museum No. TM—1343; height 31.75 mm, width 19.75 mm, presented by Mr W. Palmer.

(C) *A Pleistocene* Thracia *now admitted to the Recent fauna*

Family THRACIIDAE

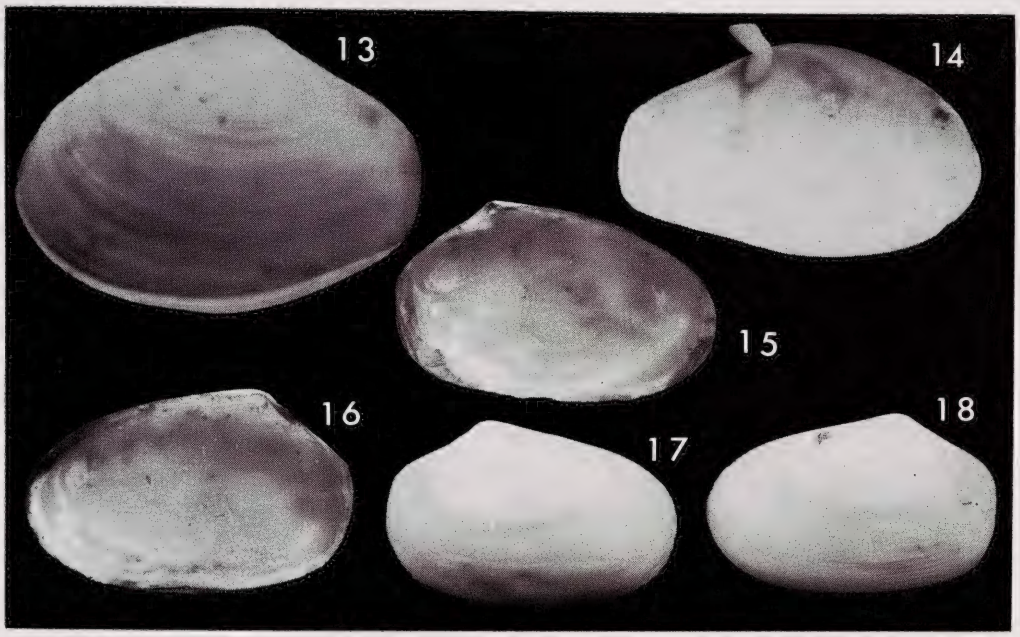
Genus **Thracia** Sowerby, 1823

Thracia vegrandis Marshall & Murdoch, 1919 (Figs. 15-18)

1919 *Thracia vegrandis* Marshall & Murdoch, Trans. Proc. N.Z. Inst. 51: 258.

This species, originally described from the Castlecliffian upper Pleistocene of Wanganui, is now claimed to be common as a Recent shell at the following localities. *Localities.* North Island; off Gannet Island, west coast, 30 fathoms (54.86 m). South Island; Negara Island, Queen Charlotte Sound, 5 fathoms (9.14 m); Tahunanui Beach, Nelson.

The species *vegrandis* is easily distinguished from the more widely dispersed *Thracia (Hunkydora) australica novozelandica* (Reeve, 1859) (Figs. 13, 14) by its smaller adult size, elongated shape with sub-parallel dorsal and ventral margins, and in particular by the minute crescentic lithodesma, only 1.2 mm long in a shell 15 mm in length. In *novozelandica* the lithodesma is angularly boomerang-shaped and proportionately very large, being 6.5 mm long in a shell 28.5 mm in length. Incidentally *Hunkydora* Fleming, 1948, is here referred back to the Thraciidae from the Myochamidae, where it was placed by Fleming.



Figs. 13-18. 13, 14. *Thracia (Hunkydora) australica novozelandica* (Reeve, 1859), Paterson Inlet, 23.77 m, Stewart Island; 21 x 32 mm (note very large lithodesma 7 mm in length). 15-18. *Thracia (Thracia) vegrandis* Marshall & Murdoch, 1919, Tahunanui Beach, Nelson; 13 x 20 mm (lithodesma only 1.2 mm in length).

(D) *New records mainly of tropical Indo-Pacific origin*

Family NATICIDAE

Polinices melanostomoides (Quoy & Gaimard, 1833)

1833 *Natica melanostomoides* Quoy & Gaimard, Voy. Astrolabe 2: 229.

1971 *Polinices (Mammilla) melanostomoides* (Quoy & Gaimard); Cernohorsky, Rec. Auckland Inst. Mus. 8: 199, figs. 66, 67.

Localities. One dead shell inhabited by a hermit crab, on mud-flat at Te Hapua, Parengarenga Harbour (K. Hipkins, Feb. 1972); another in likewise condition on sandy flat at entrance to Te Kao Channel, Parengarenga Harbour (A.W.B.P. April, 1972); also one empty shell cast ashore at Rarawa Beach, Northland (K. Hipkins, 1972).

Family TONNIDAE

Genus **Eudolium** Dall, 1889

Type (monotypy) *Dolium crosseanum* Monterosato, 1869.

Eudolium cf. **pyriforme** (Sowerby, 1914)

1914 *Dolium pyriforme* Sowerby, Ann. Mag. Nat. Hist. 14: 37.

The writer has seen a large empty shell, almost certainly of this species, that was obtained in the Doubtless Bay area, Northland, from crayfish-pots operated by a

Mangonui fisherman. The shell was in a good state of preservation, but another fisherman in the area is said to have a live taken example.

The species *pyriforme* occurs in Japan from Choshi to Honshu in 100-200 m, and is also known to occur in northern Australia. This is the first Recent record for the genus in New Zealand, but a Miocene fossil species is known from Pakaurangi Point, Kaipara (Beu 1970, Trans. R. Soc. N.Z., Earth Sci. 7 (8): 127).

Family CARINARIIDAE

Genus **Cardiapoda** d'Orbigny, 1836

Type (SD, Gray, 1847) *C. pedunculata* = *Pterotrachea placenta* Lesson, 1830.

Cardiapoda placenta (Lesson, 1830)

1830 *Pterotrachea placenta* Lesson, Voy. "Coquille" Zool. 2 (1): 253.

1965 *Cardiapoda placenta* (Lesson); Coan, "Veliger" 8 (1): 37-38.

Localities. North Island; from surface tow-netting off Cape Brett, Northland, by Mr N. Boustead, 1970-72; two shells, detached from the animal, but in a fresh condition. The species is widely distributed in the warmer waters of the Atlantic and Pacific Oceans. A new record for New Zealand.

The animal resembles *Carinaria* but has the visceral sac more posterior, and the shell is minute, no more than 2 mm in diameter, spiral, subglobose, brownish cartilaginous, and has a bilobed extension of the peristome that resembles an eye-shade.

Family FASCIOLARIIDAE

Genus **Fasciolaria** Lamarck, 1799

Subgenus **Pleuroploca** Fischer, 1884

Fasciolaria (Pleuroploca) filamentosa (Röding, 1798)

1798 *Fusus filamentosus* Röding, Mus. Bolten 2: 118.

A half-grown example, 78 mm in height, of this well known Indo-Pacific shell was obtained recently from a crayfish-pot in the vicinity of North Cape.

Family MURICIDAE

Genus **Morula** Schumacher, 1817

Subgenus **Neothais** Iredale, 1912

Type (original designation) *Purpura smithi* Brazier, 1889.

Morula (Neothais) chaidea (Duclos, 1832)

1832 *Purpura chaidea* Duclos, Ann. Sci. Nat. 26 (101): 106.

1915 *Neothais chaidea* (Duclos); Oliver, Trans. Proc. N.Z. Inst. 47: 536.

An immature living example of this species was taken in a rock pool at Merita Bay, Rangiawhia Peninsula, Northland, by Mr Hunt Seelye in 1972, and makes a new record for New Zealand. The recorded range for this species was Queensland, New Caledonia, New South Wales, Lord Howe, Norfolk and Kermadec Islands.

Family LIMIDAE

Genus **Limaria** Link, 1807

Type (SD, Winckworth) *Lima inflata* (non Gmelin) = *Ostrea tuberculata* Olivi, 1792.

Limaria orientalis (Adams & Reeve, 1850)

1850 *Lima orientalis* Adams & Reeve, Zool. Samarang (7): 75.

1926 *Lima marwicki* Powell, Rec. Canterbury Mus. 3 (1): 48.

1973 *Limaria orientalis* (Adams & Reeve); Willan, "Poirieria" 7 (1): 15.

1973 *Limaria orientalis* (Adams & Reeve); Willis, "Poirieria" 7 (1): 13.

This species was unknown in the New Zealand Recent fauna prior to the summer of 1972, after which a very considerable invasion appears to have taken place along the Northland east coast, from Leigh to Takapuna, Colville Passage, 10-12 fathoms (18.29-21.95 m) inside empty horse-mussel shells (Willis 1973, l.c.), and down the outer coast of Coromandel Peninsula to at least Mercury Bay.

At many locations, Wenderholm near Waiwera for instance, the species occurs between tides in shallow rock pools, nestling in small clumps of *Corallina* algae fringing loose boulders.

This recent invasion is probably one of several previous ones that were apparently short lived, for *orientalis* seems to be inseparable from the upper Pleistocene *Lima marwicki* Powell, 1926, of Castlecliff, Wanganui. Also, a damaged valve from the Miocene of Target Gully, Oamaru, seems to be the same species also.

Previously the Recent range of *orientalis* was considered to be Japan, Philippine Islands (type locality), New Hebrides (Willan 1973), New South Wales, Victoria and South Australia.

Family SEMELIDAE

Genus **Theora** H. Adams & A. Adams, 1843

Type (SD, Stoliczka, 1871) *Neaera lata* Hinds, 1843.

Subgenus **Endopleura** A. Adams, 1864

Type (monotypy) *Theora lubrica* Gould, 1861.

Theora (Endopleura) lubrica Gould, 1861

1861 *Theora lubrica* Gould, Proc. Boston Soc. Nat. Hist. 8: 24.

1973 *Theora* sp., Gardner, "Poirieria" 7 (1): 13.

Early in 1972 this Japanese species made a sudden appearance in many Northland east coast locations, ranging from the Bay of Islands to the upper reaches of Auckland Harbour. Dr F. Climo first informed me of the occurrence of this species in shallow water soft mud at the Bay of Islands, and at about the same time Mr R. C. Willan found it living in sticky low-tidal mud at Tutukaka. Since then the species has turned up as living colonies at many localities around Auckland. Its occurrence in fair numbers on the mud flat near the Auckland Harbour Bridge toll plaza raises a possibility that the introduction could have been associated with the harbour bridge extensions carried out by a Japanese firm, that towed prefabricated sections from Japan to the site on huge barges, but this suggested mode of introduction for the species could hardly account for the Bay of Islands and Tutukaka occurrences.
(E) *Tentative new records of tropical Indo-Pacific origin*

Family STOMATELLIDAE

Stomatia phymotis Helbling, 1779

1779 *Stomatia phymotis* Helbling, Abh. Privatges. Böhm. 4: 124.

An empty shell in a good state of preservation, of this well-known but rather uncommon Indo-Pacific species, was found in a rock pool near Te Araroa, East Cape, by Mrs R. E. Duffy in 1972. The location is remote from habitations, but nevertheless further evidence is required before admitting this species as a member of the New Zealand fauna.

Family TONNIDAE

Tonna perdix (Linnaeus, 1758)

1758 *Buccinum perdix* Linnaeus, Syst. Nat. ed. 10: 734.

1973 *Tonna perdix* (Linnaeus); Gardner, "Poirieria" 7 (2): 42.

Two small examples in fairly fresh condition, one with portions of the animal attached, and some shell fragments, of this well-known tropical Indo-Pacific species, were cast ashore on beaches between the Bay of Islands and North Cape, during the past two or three years.

Malea pomum (Linnaeus, 1758)

1758 *Buccinum pomum* Linnaeus, Syst. Nat. ed. 10: 735.

1973 *Malea pomum* (Linnaeus); Gardner, "Poirieria" 7 (2): 42.

A reasonably fresh example of this well-known tropical Indo-Pacific species was picked up last year at Great Exhibition Bay, Northland, by Mr Hunt Seelye of Pukenui, Houhora.

Family MURICIDAE

Rapana venosa (Valenciennes, 1846)

1846 *Purpura venosa* Valenciennes, Voy. "Venus": pl. 7, fig. 1.

1861 *Rapana thomasiana* Crosse, J. de Conchyl. 9: 176, 268.

Two fully adult examples of this species, the normal range of which is Japan, Korea and North China, were taken in crayfish-pots, 12 miles (19.31 km) west of Cape Maria van Diemen in approximately 48 fathoms (87.78 m), one by Mr C. Wedding in 1971 and the other by Mr P. Wedding in 1972.

Family TURRIDAE

Lophiotoma abbreviata (Reeve, 1843)

1843 *Pleurotoma abbreviata* Reeve, Conch. Iconica 1: pl. 10, fig. 86.

1973 *Lophiotoma "brevicordata"* (sic) = *abbreviata* (Reeve); "Poirieria" 7 (1): 4.

One well preserved example of this tropical Indo-Pacific reef shell, dredged in shallow water at Deep Water Cove, Bay of Islands, by Mr & Mrs Max Hancock, of Whangarei.

(F) *Previously recorded species now considered established in New Zealand*

Family CYPRAEIDAE

Lyncina vitellus (Linnaeus, 1758)

1858 *Cypraea vitellus* Linnaeus, Syst. Nat., ed. 10: 721.

1967 *Lyncina vitellus* (Linnaeus), Powell, Rec. Auckland Inst. Mus. 6 (3): 185.

1973 *Cypraea vitellus* Linnaeus; K. Grange, "Poirieria" 7 (1): 3.

Since the original record of a living example of this well-known tropical Indo-Pacific cowry in 90 feet (27.43 m) at the Poor Knights Islands (Powell 1967, l.c.), two well preserved examples have been taken at Goat Island Beach, Leigh, Hauraki Gulf, another at Tutukaka, Northland, as well as recognisable fragments washed up near Whangaroa.

Family BURSIDAE

Bursa bubo lissostoma E. A. Smith, 1914

1914 *Bursa (Tutufa) rubeta* var. *lissostoma* E. A. Smith, J. of Conch. 24: 230, pl. 4, fig. 3.

1967 *Tutufa bufo* (Röding, 1798); Powell, Rec. Auckland Inst. Mus. 6 (3): 189, pl. 36, fig. 8.

The original New Zealand record of this Indo-Pacific species (Powell 1967, l.c.) was based upon a living adult example, 140.5 mm in height, taken at the Poor Knights Islands at a depth of 150 feet (45.72 m). Since then another living adult was found at low water on a sandy flat near the entrance to the Te Kao Channel, Parengarenga Harbour. Also quite a number of well preserved shells have been taken from crayfish-pots in the Doubtless Bay and North Cape areas, as well as others cast ashore on northern beaches.

Family FASCIOLARIIDAE

Fusinus genticus (Iredale, 1936)

1936 *Colus genticus* Iredale, Rec. Aust. Mus. 19: 316.

1967 *Fusinus genticus* (Iredale); Powell, Rec. Auckland Inst. Mus. 6 (3): 194.

Since the original records of this eastern Australian species in Northland east coast waters, based upon shells inhabited by hermit-crabs, and taken from crayfish-pots, a number of living examples were cast ashore on Northland beaches during the latter half of last year. Also a fine large living example, 156 mm in height, and with the yellowish pile-like periostracum intact, was obtained by Mr W. Palmer in 120 feet (36.58 m) at the Poor Knights Islands. This specimen was presented to the Auckland Museum by Mr Palmer; the animal was orange-red to scarlet, covered all over with small white spots.

Family TEREBRIDAE

Terebra circumcincta Deshayes, 1857

1857 *Terebra circumcincta* Deshayes, J. de Conchyl. 6: 77, pl. 3, fig. 9.

1971 *Terebra circumcincta* Deshayes; Powell, Rec. Auckland Inst. Mus. 8: 225, fig. 26.

1973 *Terebra circumcincta* Deshayes; Gardner, "Poirieria" 6 (6): 118.

Since the recording of two living examples of this species, taken by shallow water dredging in the Bay of Islands (Powell 1971, l.c.), a number of living examples have been dredged in the same area by Mr G. Clifford.

(G) *Nomenclatural and other notes*

Family TROCHIDAE

Diloma nigerrima (Gmelin, 1791), based upon Chemnitz, Conch. Cab. 5: 185, fig. 3597, from "Oceano Australi" = New Zealand, makes *Zediloma digna* Finlay, 1927, an absolute synonym. Finlay and others were under the false impression that Gmelin's species was exclusively South American.

Diloma (Fractarmilla) zelandica (Quoy & Gaimard, 1834) replaces the well known name *Trochus atrovirens* Philippi, 1851. Philippi's species was wrongly assigned previously to the synonymy of *Melagraphia aethiops* (Gmelin, 1791).

Diloma (Fractarmilla) subrostrata novazelandiae (Anton, 1839), based upon Chemnitz Conch. Cab. 5: fig. 1850, replaces *Zediloma (Fractarmilla) corrosa zebrina* Powell, 1946.

Diloma (Fractarmilla) bicanaliculata (Dunker, 1844), in Philippi, Abb. Conch. 1 (8): 189, pl. 5, fig. 4, replaces *Monodonta lugubris* (non Gmelin, 1791), Suter, 1913, p. 119. Gmelin's *Trochus lugubris* was based upon Chemnitz, Conch. Cab. 5: pl. 165, fig. 1571, which is identical with *Melagraphia aethiops* (Gmelin, 1791).

Maurea selecta (Dillwyn, 1817). Dillwyn's *Trochus selectus* is an earlier name for *Trochus cunninghami* Griffith & Pidgeon, 1833.

In a concurrent paper Mr W. O. Cernohorsky ("Type specimens of Mollusca in the University Zoological Museum, Copenhagen", this volume) gives a more detailed account of the synonymy, as well as remarks concerned with the actual type specimens, of the above five species.

Zetela Finlay, 1927, is here considered of no higher status than a subgenus of *Solariella* Searles Wood, 1842.

Spectamen Iredale, 1924, replaces *Zeminolia* Finlay, 1927; personal communication from Dr F. Climo, who examined the type of Finlay's genus and found the radula to be identical with that of Iredale's *Spectamen,* as figured by the present writer, 1930. Trans. Proc. N.Z. Inst. 60: 535, textfig.

Talopena Iredale, 1918, is considered to be a better location for *Trochus carmesina* Webster, 1908, than *Thoristella* Iredale, 1915. This is on account of a distinct cleft near the top of pillar, which feature is foreign to *Thoristella.*

NEW SYNONYMY IN CRYPTOPYGUS (COLLEMBOLA: ISOTOMIDAE)

K. A. J. WISE
AUCKLAND INSTITUTE AND MUSEUM

Abstract. Six species previously recorded in *Spinurosomia* and *Parafolsomia* are transferred: *Cryptopygus* (= *Spinurosomia*) syn. n., (= *Parafolsomia*) syn. n.; *Cryptopygus caecus* (= *Folsomia lunata*) syn. n., (= *Parafolsomia litorea*) syn. n.; *Cryptopygus decemoculatus* comb. n. (= *Parafolsomia decemoculata*); *Cryptopygus novaezealandiae* comb. n. (= *Folsomia novae-zealandiae*); *Cryptopygus parasiticus* comb. n. (= *Folsomia parasitica*); *Cryptopygus quadrioculatus* comb. n. (= *Parafolsomia quadrioculata*). *Cryptopygus caecus* is recorded from New Zealand, Auckland Is, and Campbell I.

Some problems which arose during and since earlier studies of southern Collembola (Wise 1964, 1970b) have been resolved since it was realised that *Parafolsomia decemoculata* Salmon, 1949 is a species of *Cryptopygus*.

Bagnall (1949) erected the genus *Spinurosomia* for two species, *Folsomia novae-zealandiae* Salmon, 1943 (type species), *Folsomia lunata* Salmon, 1943, and Salmon, later the same year (1949), placed five species, *Parafolsomia decemoculata* Salmon, 1949 (type species), *Parafolsomia litorea* Salmon, 1949, *Folsomia lunata* Salmon, 1943, *Folsomia novae-zealandiae* Salmon, 1943, *Folsomia parasitica* Salmon, 1943, in his new genus *Parafolsomia*. All five species, some in synonymy, are now transferred to *Cryptopygus* including the type species of *Spinurosomia* and *Parafolsomia* which consequently fall in synonymy. One further species, *Parafolsomia quadrioculata* Wise, 1970, is also found to belong in *Cryptopygus*. Other species which have been placed in *Parafolsomia* (see Salmon 1964) have not been examined.

Cryptopygus Willem, 1902

Cryptopygus Willem, 1902, Résultats Voy. S.Y. Belgica (1897-1898-1899, Rapp. Sci. Zool., 11.

Spinurosomia Bagnall, 1949 (February), Ann. Mag. Nat. Hist. (12) 2: 91 (type species *Folsomia novae-zealandiae* Salmon, 1943). syn. n.

Parafolsomia Salmon, 1949 (July), N.Z. Dep. Scient. Ind. Res. Cape Exped. Ser. Bull. No. 4: 19 (type species *Parafolsomia decemoculata* Salmon, 1949). syn. n.

Cryptopygus caecus Wahlgren, 1906

Cryptopygus caecus Wahlgren, 1906, Wiss. Ergebn. Schwed. Südpolar-Exped. (1901-1903) 5 (9): 3, 12 (South Georgia).

Folsomia lunata Salmon, 1943, Trans. Proc. R. Soc. N.Z. 73 (2): 73 (New Zealand); Salmon, 1964, R. Soc. N.Z. Bull. No. 7(2): 338. syn. n.

Spinurosomia lunata: Bagnall, 1949 (February), Ann. Mag. Nat. Hist. (12) 2: 91.

Parafolsomia lunata: Salmon, 1949 (July), N.Z. Dep. Scient. Ind. Res. Cape Exped. Ser. Bull No. 4: 20.

Parafolsomia litorea Salmon, 1949, N.Z. Dep. Scient. Ind. Res. Cape Exped. Ser. Bull. No. 4: 21 (Campbell I); Salmon, 1964 (June), R. Soc. N.Z. Bull. No. 7 (2): 359; Wise, 1964 (July), Pacific Insects Monogr. 7: 187. syn. n.

Parafolsomia sp. Wise, 1970, Rec. Auckland Inst. Mus. 7: 222 (New Zealand).

Records of *Cryptopygus caecus* have been given previously (Wise 1967, 1970b, 1971) and the species was discussed by Massoud & Rapoport (1968).

A specimen from White I (New Zealand) was at first thought by me to be *Spinurosomia lunata* (Salmon, 1943) and was compared with the type of that species. These specimens were recognised as being conspecific and were considered to belong in Salmon's *Parafolsomia,* but they were also recognised as being conspecific with *Cryptopygus caecus.* For the purposes of the White I faunal list, that specimen was recorded as *Parafolsomia* sp. (Wise 1970a).

Following re-examination of many Campbell I specimens previously recorded as *Parafolsomia litorea* Salmon, 1949 (Wise 1964), together with Salmon's description, I have recognised this species as being conspecific with *Cryptopygus caecus.*

Specimens have also been found in an Auckland Is collection to hand (Auckland Is, Ocean I, Port Ross, 29.XII.1962, K. A. J. Wise).

DISTRIBUTION. The species has a southern circumpolar distribution. It has now been recorded from South Georgia Is, South Shetland Is, Tristan da Cunha (Rapoport 1971), South Africa, Kerguelen Is, New Zealand (new record), Auckland Is (new record), Campbell I (Rapoport 1971; this paper as above) and South America (Argentina, Cutini de Izarra 1965; Chile, Massoud & Rapoport 1968; Bolivia, Peru, Rapoport 1971).

Cryptopygus decemoculatus (Salmon, 1949) comb. n.

Parafolsomia decemoculata Salmon, 1949, N.Z. Dep. Scient. Ind. Res. Cape Exped. Ser. Bull. No. 4: 20 (Auckland Is); Salmon, 1954, Trans. R. Soc. N.Z. 82 (1): 216 (New Zealand); Salmon, 1964 (June), R. Soc. N.Z. Bull. No. 7 (2): 358; Wise, 1964 (July), Pacific Insects Monogr. 7: 187 (Campbell I).

Having examined specimens from Auckland Is and Campbell I, together with Salmon's description, I consider this species belongs to the genus *Cryptopygus.*

DISTRIBUTION. New Zealand, Auckland Is, Campbell I.

Cryptopygus novaezealandiae (Salmon, 1943) comb. n.

Folsomia novae-zealandiae Salmon, 1943, Trans. Proc. R. Soc. N.Z. 73 (2): 74 (New Zealand); Salmon, 1958, Trans. R. Soc. N.Z. 85: 707.

Spinurosomia novae-zealandiae: Bagnall, 1949 (February), Ann. Mag. Nat. Hist. (12) 2: 91; Salmon, 1964, R. Soc. N.Z. Bull. No. 7 (2): 332.

Parafolsomia novae-zealandiae: Salmon, 1949 (July), N.Z. Dep. Scient. Ind. Res. Cape Exped. Ser. Bull. No. 4: 20 (Auckland Is); Salmon, 1964, R. Soc. N.Z. Bull. No. 7 (2): 359.

This species has been considered in conjunction with the other *Parafolsomia* species recorded above and I have examined the type specimen.

DISTRIBUTION. New Zealand, Auckland Is.

Cryptopygus parasiticus (Salmon, 1943) comb. n.

Folsomia parasitica Salmon, 1943, Trans Proc. R. Soc. N.Z. 72 (4): 380 (New Zealand); Salmon, 1964, R. Soc. N.Z. Bull. No. 7 (2): 339.

Parafolsomia parasitica: Salmon, 1949, N.Z. Dep. Scient. Ind. Res. Cape Exped. Ser. Bull. No. 4: 20.

As Salmon (1949) considered this species to be congeneric with *Parafolsomia decemoculata* it is also transferred to *Cryptopygus.*

DISTRIBUTION. New Zealand.

Cryptopygus quadrioculatus (Wise, 1970) comb. n.

Parafolsomia quadrioculata Wise, 1970, Pacific Insects Monogr. 23: 194 (South Georgia).

At the time I was working on the South Georgia Is Collembola, this species was first thought to be in the genus *Isotomina* which has since been synonymised with *Cryptopygus* by Massoud & Rapoport (1968). It was finally placed in *Parafolsomia* due to its similarity to the other southern islands species then in that genus and which have now also been transferred to *Cryptopygus.*

DISTRIBUTION. South Georgia Is.

REFERENCES

BAGNALL, R. S.

1949 Contributions towards a knowledge of the Isotomidae (Collembola) VII-XV. *Ann. Mag. Nat. Hist.* (12) 2: 81-96 (February).

CUTINI de IZARRA, D.

1965 Fauna Colembologica de Sierra de la Ventana (Provincia de Buenos Aires, Argentina). *Physis* 25 (70): 263-276.

MASSOUD, Z. and E. H. RAPOPORT

1968 Collemboles Isotomides d'Amérique du Sud et de l'Antarctique. *Biologie de l'Amérique Australe* 4: 307-337.

RAPOPORT, E. H.

1971 The geographical distribution of Neotropical and Antarctic Collembola. *Pacific Insects Monogr.* 25: 99-118.

SALMON, J. T.

1949 New Sub-Antarctic Collembola. *N.Z. Dep. Scient. Ind. Res. Cape Exped. Ser. Bull.* No. 4: 1-56 (July).

1964 An index to the Collembola. *R. Soc. N.Z. Bull.* No. 7 (2): 145-644 (June).

WISE, K. A. J.

1964 Insects of Campbell Island. Collembola. *Pacific Insects Monogr. 7:* 178-207 (July).

1967 Collembola (Springtails). *In* J. L. Gressitt (Ed). Entomology of Antarctica. *Ant. Res. Ser.* 10: 123-148.

1970a On the terrestrial invertebrate fauna of White Island, New Zealand. *Rec. Auckland Inst. Mus.* 7: 217-252.

1970b Collembola of South Georgia. *Pacific Insects Monogr.* 23: 183-208.

1971 The Collembola of Antarctica. *Pacific Insects Monogr.* 25: 57-74.

INDEX TO VOLUME 11

Acaena agnipila var. *aequispina* 119
Acaena anserinifolia complex 119
Acaena × *anserovina* 119
Acaena novae-zelandiae 119
Acaena ovina complex 119
Acaena ovina var. *ambigua* 119
Adzes 1
Anadara trapezia 193
Bailey 111
Bursa bubo lissostoma 205
Canby 108
Cancilla (Ziba) bantamensis 131
Cantharus (Pollia) wrightae 124
Cardiapoda placenta 202
Carving 103
Cernohorsky, W. O.
The taxonomy of some Indo-Pacific Mollusca with description of a new species. Part 2 121
Type specimens of Mollusca in the University Zoological Museum, Copenhagen 143
Cheeseman 105
Chemnitz 145
Collembola 209
Conus excelsus 133
Conus moluccensis 134
Conus proximus 138
Cryptopygus caecus 209
Cryptopygus decemoculatus 210
Cryptopygus novaezealandiae 210
Cryptopygus parasiticus 211
Cryptopygus quadrioculatus 211
Davidson, Janet M.
Further identifications of sources of obsidian flakes from N38/37 on Motutapu Island, New Zealand 11
Radiocarbon dates from Sunde site (N38/24), Motutapu Island, New Zealand 9
Some hafted shell adzes in the Auckland Museum 1

Engina contracta 126
Eudolium cf. *pyriforme* 201
Excavations 23
Fasciolaria (Pleuroploca) filamentosa 202
Fleming, C. A., and A. W. B. Powell
Three radiocarbon dates for Quaternary Mollusca from Northland 193
Fox, Aileen
The pa, N43/59, at Pawhetau Point, Kawakawa Bay, Clevedon, South Auckland 15
Fusinus genticus 205
Goulding, Jeanne H.
Notes on the Cheeseman Herbarium. Part 1. Exchange with U.S.A. herbaria before 1900 105
Holm 111
Indo-Pacific Mollusca 121
Leahy, Anne
Excavations at Hot Water Beach (N44/69), Coromandel Peninsula 23
Limaria orientalis 203
Lintel 101
Lophiotoma abbreviata 205
Lyncina vitellus 205
Malea pomum 204
Martindale 105
Martini 143, 145
Mollusca 121, 143, 193, 197
Moltke 145
Morong 109
Morula (Neothais) chaidea 202
Morwood, M. J.
A functional analysis of obsidian flakes from three archaeological sites on Great Barrier Island and one at Tokoroa 77
Murex (Haustellum) dentifer 123
Myochama tasmanica 197
Obsidian 11, 13, 17
Orchard, A. E.
A note on the type of *Acaena ovina* var. *ambigua* Kirk (Rosaceae) 119
Pawhetau pa 15
Placostylus ambagiosus priscus 194

Polinices melanostomoides 201

Powell, A. W. B.

New Zealand Molluscan systematics with descriptions of new species. Part 8 197

Powell, A. W. B. C. E. Fleming and —

Three radiocarbon dates for Quaternary Mollusca from Northland 193

Pterochelus paupereques 199

Radiocarbon dates

charcoal 9

molluscs 193

Rapana venosa 204

Rhinoclavis brettinghami 121

Rosaceae 119

Simmons, D. R.

A carving from Kaikohe 103

A lintel from South Kaipara Head 101

Spengler 146

Stomatia phymotis 204

Strongylocera 128

Terebra circumcincta 206

Theora (Endopleura) lubrica 203

Thracia vegrandis 200

Tonna perdix 204

Ward, G. K.

Source of obsidians from the Motutapu undefended site N38/37 13

Wise, K. A. J.

New synonymy in *Cryptopygus* (Collembola: Isotomidae) 209

RECORDS AND BULLETIN OF THE AUCKLAND INSTITUTE AND MUSEUM

Instructions for Authors

The *Records* and *Bulletins* contain the results of original research dealing with material in the collections of the Museum, and research carried out by members of the Museum staff in their particular subjects. The fields covered include taxonomic and general botany and zoology, palaeontology, geology and anthropology (archaeology and ethnography).

Before completion of a manuscript, authors should refer to papers on a similar subject in the most recently published volume for detail of format required. Any doubts should be referred to the Editor. Standard rules for scientific papers and taxonomy apply; an acceptable guide for style is the New Zealand Government Printing Office Style Book (1971 edition).

Manuscripts should be typed, double-spaced on one side of white foolscap, International A4, or quarto sheets, with a 2.5 cm (or 1 inch) margin on *both* sides of page. Two copies of text are required, second copies of figures are preferred but not demanded. Manuscripts should not be in booklet form, but supplied with figures, figure captions, tables with captions above, all separate, with only an indication of position required in the text.

Abstracts are required except for brief papers with adequate title.

Figures (particularly groups of figures) and tables should be composed to page proportions, with due regard to saving space, and must be supplied ready for reduction (where necessary) to the printed page size or less (allowing for captions — above tables, below figures), preferably upright on page but sideways on page accepted (where necessary). Figures for fold-outs will only be allowed in special circumstances. Individual figures (whether grouped or not) should be numbered consecutively in arabic numerals (*not* 1a, b, c, etc) regardless of whether they are photographs or line drawings. Figures and tables *must* be referred to in the text and should be numbered in order of reference where possible.

All measurements must be given in metric (SI) units; equivalents in other units may be given in parenthesis.

Entries listed under "References" *must* be referred to in the text; this may not be necessary for a "Bibliography" or "Selected Bibliography" provided such listing is explained in the text. Book titles need not be abbreviated but names of journals should be abbreviated to known standards (as in "The world list of scientific periodicals" 4th edition, or as in the journal itself, or by a combination of recognised abbreviations), but need not be over-abbreviated. Names of countries may be abbreviated but those of cities or provinces are preferred not abbreviated. English book titles should be in lower case except for the first letter of names, but names of journals should have all major words beginning with a capital letter. Those of foreign languages should have capital letter usage of the language concerned.

Authors are responsible for the accuracy of their data, references and quotations, for their conclusions and remarks, and also for corrections to proofs. Authors (whether single or joint) will receive 50 free reprints.

Papers may be offered to the Editor at any time but those received for the Records after 31 March of any year may not be considered for publication that year. All papers will be submitted to the Editorial Committee and may be submitted to a referee.

UNITY PRESS LTD.